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SCIENCE AND THE STATE OF MIND[1]

By Dr. WESLEY C. MITCHELL

PROFESSOR OF ECONOMICS AT COLUMBIA UNIVERSITY; PRESIDENT OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

YOUR president's invitation to address the American Science Teachers Association both flattered and intimidated me. An economist who has any inkling of what mathematics, astronomy, physics, chemistry and biology in its numerous branches have accomplished is grateful when representatives of these shining disciplines admit him to their company. But he feels that in their company his proper role is that of listener, not of speaker. Your techniques are far more advanced than his, your results are more securely established, you have and you merit higher prestige both in intellectual circles and with the general public. From you an economist should be able to learn much; whether he can make any return in kind is doubtful.

Yet there is a way of conceiving science that rationalizes, and perhaps justifies, both your invitation to speak and my acceptance. Despite the bewildering specialization of scientific inquiries, it is permissible to think of science as a unit. A physicist may not understand the technical papers of a physiologist, and *vice versa;* but the two workers approach their problems in the same spirit. Both workers seek to unite accurate observation of phenomena with systematic analysis of relations; neither expects that his results will be accepted unless they are confirmed by competent investigators who repeat his experiments and check his reasoning; each realizes that what he observes and what he thinks is influenced by a personal equation, but each tries to keep this factor from warping his conclusions more than is inevitable.

In short, we cherish the ideal that all scientific men are single-minded in their search for truth. We expect them to avoid wishful thinking; that is, they must not alter their findings to suit the non-scientific beliefs or longings or dislikes of others or themselves. All of them are supposedly ready to expose their results to criticism by their fellows. We admit that it is difficult to live up to this ideal. Probably all of us are conscious of lapses in ourselves from strict scientific integrity, and suspect lapses in others. But we hold to our ideal as the state of mind that is characteristic of scientific work, whether that work is in mathematics or botany, geology or anthropology, chemistry or economics.

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[1] Address given at the luncheon of the American Science Teachers Association, Richmond, Virginia, December 29.

Men can treat any subject that excites their curiosity in this single-minded, critical, austere spirit. But some subjects are far easier than others to treat scientifically. These relatively easy subjects were the first ones to be brought within the realm of science, and they are the subjects in which science has made the greatest progress. Euclidean geometry and mechanics may serve as examples. The subjects that are harder to treat single-mindedly, critically and austerely were long dominated by non-scientific types of thinking—by worldly wisdom that scorned theory, by soaring speculation that was impatient of observation, by inner illumination that forbade skepticism. But the cumulative successes won by the scientific spirit in dealing with the easier subjects have embodied men in successive generations to extend the realm of scientific inquiry far beyond its early strongholds. While the older sciences were growing in reach and power, younger sciences were being born and passing through the diseases of infancy. It is as characteristic of the scientific spirit to beget new children as to lavish ever greater care upon the nurture of its elder offspring.

Economics is no longer the youngest child of science, but it is still an infant. Perhaps a century is an appropriate unit in which to reckon the age of a science. In that reckoning economics is barely two, whereas some of the sciences represented here claim to be more than two hundred—they have lost their birth certificates and don't know exactly how old they are. I hasten to add that in so long-lived a family two hundred represents, not decrepitude, but lusty youth.

Of course the very young sciences don't know how to behave as well as their elders. They have to crawl before they can walk, to walk before they can run. They make incoherent noises before they learn to talk intelligently: while they are learning to talk they use a limited vocabulary borrowed from others and not well adapted to their own needs. They are often obstreperous. Their more mature brothers and sisters feel at times like disowning them. But they are legitimate offspring of the same spirit that begot astronomy and mathematics, and if they are true to their begetter they will gradually acquire competence and grace. Yet the road before them is hard; for they are young precisely because the subjects with which they deal present graver difficulties than those with which the elder sciences deal.

We should not forget, however, that the more mature sciences had hard times in their younger ages. They encountered both inner and outer obstacles that they had to surmount by long-continued efforts. Let me recur to the examples of geometry and mechanics. We all know how the later Greek geometers got bemused by hazy speculations concerning the mystical significance of their constructions, and how Galileo's deductions got him persecuted by the church. I take the first to be an example of the inner, and the second to be an example of the outer, difficulties that science encounters in its search for truth—difficulties that assume ever-changing forms as this search is pressed into new territory.

It was pointed out long ago by a great psychologist that we can see the motes in our neighbors' eyes more easily than we can see the beams in our own eyes. Let us take easy things first, and consider some of the external difficulties that laymen put in the way of scientific work to-day.

I might take as an example of external obstacles to scientific work interference with the teaching of biology by those who think their religious beliefs are endangered by what they conceive to be the "doctrine of evolution." But that is too familiar and too obvious an issue to belabor. Nor need I dwell upon the efforts of the present masters of Germany to make science subservient to nationalistic ends. We all look forward to the day when German investigators can rejoin the international army of research workers, and assert again the right to freedom of inquiry and freedom of teaching their predecessors did so much to win for the world. It is better worth while to consider issues on which our minds are not so clear.

In all our schools children are taught American history. Now history may not claim to be a science, but a historian may have a scientific frame of mind. He may be single-minded in his effort to find out what "really happened"; he may be critical in his use of sources; he may strive to avoid wishful thinking. But if some of his conclusions run counter to the patriotic feelings of the parents of school children, he may find his intellectual virtues charged against him as faults. Some people who are ready to admit their own shortcomings feel shocked if their national heroes are represented as fallible. Many who are critical of current developments in our national life like to think of our national past as a record of stern virtues. If they admit that our country has at times gone wrong, they may still hold that patriotism should be inculcated in the rising generation, and that the safest road to that end is to soft-pedal unhappy errors and to stress what they approve. But a man who twists the truth, even for the best of ends, is doing violence to the scientific spirit. Teachers of science have so great a stake in free inquiry that they should stand shoulder to shoulder with any of their colleagues who may be attacked because their findings are unpalatable to school authorities, to the general public or to special interests.

Similar issues sometimes become acute in teaching children about the way in which our governments, local, state and national, are organized and how they work. The instructor often finds it safer to confine himself to the pretty arrangements of municipal charters and county governments, the state and the federal constitutions. But teaching thus confined is poor preparation for performing the duties of a citizen. The future voter needs to know how aldermen and mayors, members of the legislature, county officials, congressmen and presidents are really chosen, the pressures under which they act and the arts by which political campaigns are conducted. Every alert adult knows that political practice often differs widely from political theory, but many prefer that children be brought up on what ought to be rather than upon what is. No scientifically minded man would advocate courses in muckraking; they would be as one-sided as political platitudes. There is always the possibility that some ardent reformer will try to make his classroom a center of propaganda, and claim to be suffering for righteousness' sake when he is discharged for incompetence or intellectual intemperance. The individual cases that crop up in this connection are often difficult to judge; for political science is one of the youngest children of the scientific spirit, and has as yet accumulated few assured findings. But those who have the will to stand for intellectual honesty can at least tell whether a man under attack has a scientific temper, the ability to observe objectively and to think dispassionately.

It may be agreeable to us as science teachers to dwell only upon obstacles that are put by others in the way of our work. But that would be treachery on our part to the scientific spirit. Our own professions require that we face also the inner obstacles that are raised by our own faults, intellectual and emotional. My impression is that these obstacles within us are more difficult to overcome than the obstacles without. Since the subject is a delicate one, I shall take my own discipline as the first and, you may think, the worst example.

Economics deals with the behavior of men in making a living. In modern times, most men get most of their livings by making and spending money incomes. This is an activity in which practically all adults have to engage, economists among the number. Both in making money and in spending money we have to defend our individual interests against people who would like to pay us less and charge us more than we like. There is a conflict of interests in almost every transaction in which we engage. As individuals we can often do little to defend ourselves against what we deem exploitation, or to exploit others—a term that we seldom apply to our own actions—others may save us the trouble. So we unite with people in positions like our own to form trade unions, trade associations, bondholders' committees, tax-payers' leagues, and the like, and we make the interests of these groups our own.

Thus economists can not be disinterested observers of economic behavior; they are participants in economic struggles. It is therefore far harder for an economist to be a single-minded, critical austere investigator than it is for a man who studies the behavior of gases or electrons or sea-urchins. Even if a man can set aside his individual interests, and there have been economists who have worked hard for policies that would cost them heavily, he can hardly divest himself of the preconceptions and emotional attitudes formed in him before he knew what economics is. Consciously or unconsciously, and the latter is the more insidious bias, he feels an urge for or against certain views. Much of orthodox economic theory is an open or a covert defence of private property and free enterprise in pursuit of profit. Perhaps there is as large a literature that attacks this form of organization under the guise of what purports to be scientific analysis.

Paraphrasing a passage in the presidential address that Edwin G. Conklin delivered before the American Association last year, let me say that science is concerned to show only what is true and what is false. By so doing it is of inestimable value in helping men to decide what is good for them and what is bad. But science itself does not pronounce practical or esthetic or moral judgments. The investigator who tries to persuade men that they should choose one course of action rather than another may be drawing sensible conclusions from his scientific findings, but he is certainly not doing scientific work when he does so. The investigator who consciously or unconsciously allows his preferences to shape or color his scientific findings is offending the scientific spirit. He may make contributions to our knowledge of what is true and what is false in the course of his analysis; but that will be a fortunate accident. Perhaps some attacks upon and defences of forms of economic organization are meritorious performances from other view-points; but they are not scientific, and whatever analysis of economic processes is incidental to them must be suspect. For the man who has a cause at heart, however fine that cause may be, is likely to prove a biased observer and a sophisticated reasoner. Economists find it peculiarly difficult to preserve a scientific frame of mind just because they deal with issues about which they and their fellows feel intensely.

Not to leave the impression that economists alone face inner obstacles when they try to do scientific work, let me recall a few derangements from which most of us suffer in some degree. We have our personal likes and dislikes that make it hard for us to assess impartially the scientific contributions of our fellow workers. Often these emotional aberrations take the still more irrational form of living or disliking large groups of people whom we don't know but about whom we imagine things. Who among us maintains a strictly scientific attitude toward what is called the race issue, either in the form that is acute in Germany or in the form that is acute in the United States? To be more offensively personal, is there any one so free from vanity that he can be strictly scientific about critical appraisals of his own work? And on a higher level, are not most of us conscious of an unreasoned predilection for certain types of scientific inquiry balanced by an equally unreasoned tendency to depreciate the value of other types?

I should hesitate to talk in this vein to any company not composed of scientific investigators. Just because other groups would probably have more biases per gram of gray matter than can be found in this room at present, it would be futile to dwell upon their intellectual limitations. Little but annoyance could result. But we who profess to follow the scientific ideal can face even our own deficiencies and lapses from grace in a scientific spirit. And the firmer our scientific temperaments, the readier we are to overcome so far as human nature allows the inner obstacles to scientific work.

We have, indeed, a high calling, and much depends upon how we acquit ourselves. Progress in human well-being is conditioned by progress in discovery in both the natural and the social sciences. Scientific discoveries are made by gifted individuals; but these individuals have to be conditioned for their work, and this conditioning is a social process. Even more patently, the application of scientific discoveries to human uses, good or bad, is work in which thousands share. Many citizens of the future have their most vivifying contacts with science through us. We do not expect to make many of them scientific lights, but we do expect to give most of them some impression not only of what science has accomplished but also of the spirit in which scientific men work, thus to influence their future attitudes toward science, and to promote the social processes that favor scientific discoveries and their applications. The most effective way to exercise this influence upon others is to cultivate the scientific spirit in ourselves.

SCIENTIFIC EVENTS

THE NEW GEOLOGICAL GLOBE AT THE SOUTH KENSINGTON GEOLOGICAL MUSEUM

IT is reported in the London *Times* that a geological globe, 5 feet 11 inches in diameter and electrically rotated at the rate of one revolution in 2½ minutes, was formally set in operation at the Geological Museum, South Kensington, on October 10, by Sir Frank Smith, secretary of the Department of Scientific and Industrial Research. This globe, which is believed to be the largest yet prepared to show both surface relief and the distribution of geological formations, was modelled by C. d'O. Pilkington Jackson and was colored by the museum staff, the painting being carried out by Mr. C. Keefe under the direction of Mr. A. J. Butler.

The scale adopted is approximately 1 in 7,000,000, or one inch to 112 miles. Mountain heights are exaggerated 20 times, and one of the most striking impressions which the new globe creates, according to the *Times,* is that of the comparative insignificance of even the loftiest mountains, for in spite of this exaggeration the summit of Everest projects scarcely more than an inch above sea-level. The globe rotates on its polar axis nearly 600 times as fast as does the earth, but the actual speed of a point on the surface of the earth is about 12,000 times that of the corresponding point on the model.

The various rocks of the earth's surface are shown by a graded series of colors, ranging from deep purple for the oldest rocks, formed perhaps 1,000,000,000 years ago, through shades of blue, green and yellow to a flesh-pink for the large areas covered by deposits laid down during and since the Ice Age. The igneous rocks are colored scarlet and orange. Ice-caps, rivers and lakes are also marked.

PERMANENT SCIENCE FUND OF THE AMERICAN ACADEMY OF ARTS AND SCIENCES

INCOME from the Permanent Science Fund, according to agreement and declaration of trust, shall be applied by the American Academy of Arts and Sciences to such scientific research as shall be selected ". . . in such sciences as mathematics, physics, chemistry, astronomy, geology and geography, zoology, botany, anthropology, psychology, sociology and economy, history and philology, engineering, medicine and surgery, agriculture, manufacturing and commerce, education and any other science of any nature or description whether or [illegible] now known or now recognized as scientific; and may be applied to or through public or private associations, societies or institutions, whether incorporated or not, or through one or more individuals."

Applications for grants under this indenture are considered by a committee of this academy on stated dates only. The next such meeting will be to consider applications received in proper order on blank forms furnished by the committee on March 1, 1939. Correspondence, including requests for application blanks, should be addressed to the chairman of the Committee on the Permanent Science Fund, Professor John W. M. Bunker, Massachusetts Institute of Technology, Cambridge, Mass.

Grants-in-aid from this fund were voted by the academy on October 19, 1938, as follows:

Professor D. C. Carpenter, New York State Experiment Station, Geneva, N. Y., $300, toward the purchase of optical equipment for an investigation of the effect of neutral salts on amino acids and proteins.

Dr. V. I. Cheadle, instructor in botany, Rhode Island State College, Kingston, R. I., $300, toward the cost of technical assistance in the preparation of material for the study of the conductive system in a group of the Monocotyledonae.

Dr. S. R. Gifford, Northwestern University Medical School, Chicago, Ill., $500, toward the cost of technical assistance in a study of the relation of the physical change of protein molecules in cataract of the eye.

Professor W. L. Gilliland, University of Maine, Orono, Maine, $250, toward the purchase of precision equipment for use in studying certain equilibria in Grignard reagents.

Professor F. L. Humoller, Loyola University School of Medicine, Chicago, Ill., $400, toward the cost of animals and materials in a study of the chemistry of a toxic fraction prepared from *Salmonella enteritidis*.

Dr. Valy Menkin, instructor in pathology, Harvard Medical School, Boston, $500, toward the cost of an investigation of the nitrogenous substances in areas of injury.

Professor Gregory Pincus, Clark University, Worcester, Mass., $800, for technical assistance and supplies in the further study of the development of artificially activated mammalian ova *in vivo* and *in vitro*.

Professor G. W. Prescott, Albion College, Albion, Mich., $175, toward the expenses of an investigation of phytoplankton in the Panama Canal Zone.

Professor Christianna Smith, Mount Holyoke College, South Hadley, Mass., $200, for the purchase of animals in a study of the origin and differentiation of red blood corpuscles.

Dr. Oswald Tippo, instructor in botany, University of Illinois, Urbana, Ill., $75, for the cost of text figures necessary for the effective publication of a monograph on the Moraceae.

Professor Dorothy W. Weeks, Wilson College, Chambersburg, Pa., $500, for technical assistance in extension of the analysis of the spectrum emitted by neutral iron atoms.

LEIGH HOADLEY,
Corresponding Secretary

AWARD OF THE HOOVER MEDAL OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

JOHN FRANK STEVENS, civil engineer of Baltimore, Md., who is now eighty-five years old, has been selected as the third recipient of the Hoover Medal, according to an announcement made by Dr. Gano Dunn, chairman of the Hoover Medal Board of Award. The medal will be presented to Mr. Stevens during the annual meeting of the American Society of Civil Engineers in New York City, which will be held from January 18 to 21, with the following citation:

> John Frank Stevens, engineer of great achievement as illustrated in his work on the Panama Canal, who, in his dealings with the Inter-Allied Forces in Siberia in the Great War, demonstrated those broader capacities for humanitarian public service beyond his calling which have earned for him the recognition of the Hoover Medal for 1938.

Mr. Stevens was born in West Gardiner, Me., on April 25, 1853. After serving as assistant engineer of the City of Minneapolis from 1874 to 1876, he became chief engineer of the Sabine Pass and North-Western Railway, followed by engineering service on practically every railroad in the Northwest, including the Chicago, Milwaukee and St. Paul, the Canadian Pacific and the Great Northern. Then in 1905 he was appointed chief engineer of the Panama Canal and later chairman of the Isthmian Canal Commission. From 1907 to 1909, he was vice-president in charge of operations of the N. Y., N. H. and H. R. R. Following this, he became president of several West Coast railroads.

In 1917, Mr. Stevens, then sixty-four years of age, went to Siberia as chairman of the Commission of Railway Experts to assist the Russian Provisional Government in the reorganization and operation of its badly organized railways. The Armistice and the Soviet ascendency stopped this work. However, Mr. Stevens remained in Manchuria and, with the collaboration of the American Ambassador to Japan, formed the Inter-Allied Technical Board, becoming president of it. Amidst revolution, disease and famine, Mr. Stevens and a band of devoted American railway men operated the crippled railways and kept open "the back door to Russia." As a result, the Allied troops in Siberia were withdrawn successfully, the railway operations maintained in the face of physical and personal difficulties, supplies and foodstuffs provided and the lives of thousands of natives saved.

In 1927, he was elected president of the American Society of Civil Engineers. Mr. Stevens has had awarded to him the John Fritz Medal for "great achievements," the U. S. Distinguished Service Medal and the Gold Medal of the Franklin Institute. He is an officer of the French Legion of Honor and holds membership in the North Carolina Society of Engineers, the Pacific Society of Engineers, the Chinese-American Association of Engineers and the Engineers Club of Philadelphia.

The Hoover Medal was formally instituted on April 8, 1930, during the celebration of the fiftieth anniversary of the American Society of Mechanical Engineers, to commemorate the civic and humanitarian achievements of Herbert Hoover and to whom the first award was made. The second recipient was Ambrose Swasey in 1936. Conrad N. Lauer, fellow of the American Society of Mechanical Engineers and president of the Philadelphia Gas Works, created the award in 1929 with the gift of a trust fund which is held by the American Society of Mechanical Engineers and administered by the Hoover Medal Board of Award, consisting of representatives of the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers.

OFFICERS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

A full account of the Richmond meeting of the American Association for the Advancement of Science and the scientific societies associated with it, edited by the permanent secretary, will be printed in the issue of Science for February 3.

Officers for 1939 were elected as follows:

President: Walter B. Cannon, Harvard University.

Vice-presidents of the Association and chairmen of the sections:
Mathematics (A): Marston Morse, Princeton University.
Physics (B): E. O. Lawrence, University of California.
Chemistry (C): Roger Adams, University of Illinois.
Astronomy (D): C. A. Chant, David Dunlap Observatory, Richmond Hill, Ontario, Canada.
Geology and Geography (E): Kirk Bryan, Harvard University.
Zoological Sciences (F): W. R. Coe, Yale University.
Botanical Sciences (G): Neil E. Stevens, University of Illinois.
Anthropology (H): Neil Judd, U. S. National Museum.
Psychology (I):
Social and Economic Sciences (K): Warren S. Thompson, Scripps Foundation, Miami University, Oxford, Ohio.
Historical and Philological Sciences (L): L. C. Karpinski, University of Michigan.
Engineering (M):
Medical Sciences (N): C. J. Wiggers, Western Reserve University.
Agriculture (D): Henry Schmitz, University of Minnesota.
Education (Q): M. R. Trabue, Pennsylvania State College.

Members of the Sectional Committees:
Mathematics (A): W. M. Whyburn, University of California at Los Angeles.
Physics (B): E. U. Condon, Westinghouse Research Laboratories, East Pittsburgh.
Chemistry (C): M. T. Bogert, Columbia University.
Astronomy (D): Robert H. Baker, University of Illinois.
Geology and Geography (E): William W. Rubey, U. S. Geological Survey.
Zoological Sciences (F): J. T. Patterson, University of Texas.
Botanical Sciences (G): E. N. Transeau, the Ohio State University.
Anthropology (H): Frank Speck, University of Pennsylvania.
Psychology (I):
Social and Economic Sciences (K): Carl Snyder, New York, N. Y.
Historical and Philological Sciences (L): Henry E. Sigerist, the Johns Hopkins University.
Engineering (M):
Medical Sciences (N): E. W. Goodpasture, Vanderbilt University.
Agriculture (O): H. C. Thompson, Cornell University.
Education (Q): Edward S. Evenden, Columbia University.

The Council: H. W. Odum, University of North Carolina; W. T. Vaughan, Richmond, Virginia.

The Executive Committee: J. McKeen Cattell, Garrison, N. Y.; Burton E. Livingston, the Johns Hopkins University, and Esmond R. Long, Henry Phipps Institute, Philadelphia (to fill the term vacant by the death of Earl B. McKinley).

Members of the Committee on Grants-in-aid: R. C. Fuson, University of Illinois; Vincent du Vigneaud, Cornell University Medical School.

Member of the Finance Committee: Charles S. Baker, Washington, D. C.

Nomination for Board of Trustees of Science Service: E. G. Conklin, Princeton University.

RECENT DEATHS AND MEMORIALS

Dr. Thomas Wingate Todd, Henry Wilson Payne professor of anatomy at Western Reserve University and director of the Hamann Museum of Comparative Anthropology and Anatomy, died on December 28 in his fifty-fourth year.

Dr. Calvin Blackman Bridges, known for his work in genetics at Columbia University and the California Institute of Technology under the Carnegie Institution, died on December 27 in his fiftieth year.

Arthur C. Veatch, consulting geologist, previously geologist of the U. S. Geological Survey and head of the exploration department of the Sinclair Oil Company, died on December 24 at the age of sixty years.

DR. ROBERT RIDGWAY, consulting engineer, who retired as chief engineer of the Board of Transportation of New York City in 1932, died on December 19. He was seventy-six years old.

LLOYD LOGAN, professor of chemical engineering and head of the department at Syracuse University, died on December 29 at the age of forty-eight years.

DR. CHARLES J. STUCKY, who retired as head of the department of biochemistry in the School of Medicine of Georgetown University in 1936, died on December 26 at the age of forty-two years.

DR. SAHACHIRO HATA, assistant director of the Kitasato Institute for Infectious Diseases at Tokyo, Japan, died on November 22. He was co-discoverer of salvarsan with Paul Ehrlich.

IT is announced in *Nature* that the Cambridge University Press will publish shortly "Karl Pearson," a memoir consisting of two articles by his son. It surveys his life from his earliest days, giving extracts from letters to show the development of his philosophy and details of his many activities. It is illustrated with many portraits, and there are appendices summarizing his unpublished lectures and reports.

SCIENTIFIC NOTES AND NEWS

IN the New Year's honor list of King George of England the Order of Merit is conferred on Sir James Jeans, known for his work in mathematical physics and his books for the popularization of science. Sir James was professor of applied mathematics at Princeton University from 1905 to 1909. Five other scientific men are members of the order at the present time. These are Sir J. J. Thomson, Sir William Bragg, Sir Frederick Gowland Hopkins, Sir Charles Sherrington and Sir Arthur Eddington. Knighthood was conferred on Dr. Robert Robinson, professor of chemistry at the University of Oxford.

PROFESSOR HARLOW SHAPLEY, director of the Harvard College Observatory, has been elected a member in the section of astronomy, and Prince Louis-Victor de Broglie, of the Institut Poincaré, Paris, a member in the section of physics, of the Royal Swedish Academy of Sciences.

THE annual prize of $1,000 of the American Association for the Advancement of Science for a scientific paper presented at the meeting was awarded at Richmond to Dr. Norman R. F. Maier, of the University of Michigan, for his paper entitled "Experimentally Produced Neurotic Behavior in the Rat."

EDWARD A. WHITE, professor of floriculture and head of the department at Cornell University, has been awarded the gold medal of the Massachusetts Horticultural Society "for outstanding services in the field of horticultural education." Professor White organized the first department of floriculture in the United States at the Massachusetts Agricultural College in 1907.

ERNEST A. WILDMAN, professor of chemistry at Earlham College, Richmond, Ind., has received the faculty surprise award "as a great teacher of chemistry."

DR. WILLIAM H. PARK, until his retirement two years ago director of the Bureau of Laboratories of the Department of Health, New York City, observed his seventy-fifth birthday on December 30.

DR. T. WAYLAND VAUGHAN, emeritus professor of oceanography at the University of California and emeritus director of the Scripps Institution at La Jolla, was elected president of the Geological Society of America at the New York meeting. He succeeds Dr. Arthur L. Day, who retired recently as director of the Geophysical Laboratory of the Carnegie Institution.

DR. MAXWELL NAYLOR SHORT, professor of petrography at the University of Arizona, was elected president of the Mineralogical Society of America, succeeding Dr. J. Ellis Thomson, of the University of Toronto.

DR. RALPH W. CHANEY, professor of paleontology and head of the department at the University of California, was elected president of the American Paleontological Society, succeeding Dr. C. W. Gilmore, of the U. S. National Museum. Professor A. S. Romer, of Harvard University, was elected vice-president and Professor R. R. Shrock, of the Massachusetts Institute of Technology, treasurer.

AT the closing meeting in New York City on December 29 of the thirty-seventh session of the American Anthropological Association Dr. Diamond Jenness, curator of anthropology of the National Museum of Canada at Ottawa, was elected president to succeed Dr. Edward Sapir, Sterling professor of anthropology and linguistics at Yale University. Other officers elected were: *First vice-president,* Dr. John M. Cooper, of the Catholic University of America; *Second vice-president,* Dr. Earnest Albert Hooton, professor of physical anthropology at Harvard University; *Third vice-president,* Dr. W. Duncan Strong, associate professor of anthropology at Columbia University; *Fourth vice-president,* Dr. Ruth Benedict, head of the department of anthropology at Columbia University; *Secretary,* F. M. Stezler, of the Smithsonian Institution; *Treasurer,* Bella Weitzner, of the American Museum of Natural History; *Editor of The American Anthropologist,* Dr. Ralph Linton, professor of anthropology at Columbia University. New members of the executive committee are Dr. Robert Redfield, dean of the division of social sciences of the University of Chicago; Dr. Elsie Clews Parsons, of Harrison, N. Y., and Dr. Robert W. Lowie, professor of anthropology at the University of Chicago.

DR. ENRICO FERMI, professor of physics at the University of Rome, will join the department of physics of Columbia University early in January. Professor Fermi was visiting professor at the summer session in 1936.

IT is announced in Washington that C. C. Conser has been made director of the western division of the Agricultural Adjustment Administration to succeed George E. Farrell.

DR. JOSEPH B. HOWLAND, since 1919 superintendent of the Peter Bent Brigham Hospital, retired on January 1 and has been succeeded by Dr. Norbert Anton Wilhelm, formerly assistant superintendent at the hospital, who has been since last April head of the Butterworth Hospital in Grand Rapids, Mich.

DR. JOHN R. MINER, associate statistician in the U. S. Public Health Service and formerly associate professor of biology in the School of Hygiene and Public Health of the Johns Hopkins University, has been appointed associate editor of the Mayo Clinic.

IT is reported in *Industrial and Engineering Chemistry* that Dr. W. Albert Noyes, Jr., head of the department of chemistry at the University of Rochester, who was elected editor-in-chief of *Chemical Reviews* at the Dallas meeting of the American Chemical Society, assumes direction of the journal this month. He succeeds to the position created by his father, Dr. Wm. A. Noyes, in 1924, becoming the third editor of the journal. Dr. Gerald Wendt, who has served as editor since 1927, submitted his resignation at Dallas to devote his entire time to his work as director of science at the New York World's Fair.

THE following changes have been made in the staff of the Field Museum of Natural History: William H. Corning, chief engineer since 1920, has been promoted to be superintendent of maintenance, filling the vacancy caused by the recent death of John E. Glynn; William E. Lake, formerly assistant engineer, becomes chief engineer; Arthur G. Rueckert, a staff taxidermist since 1923, has been appointed staff artist, and will have charge of the painting of backgrounds for habitat groups, replacing the late Charles A. Corwin. Other new appointments are Robert L. Yule, preparator in the department of anthropology, and W. E. Eigsti, a staff taxidermist.

DR. HERBERT E. BOLTON, chairman of the department of history at the University of California, who at the request of the university acted as an observer at the Pan-American Conference in Peru, is now visiting the universities of Chile, Argentina and Brazil in the interests of cultural relations between these universities and the University of California. Afterwards he expects to spend a short time visiting Caribbean lands, returning to the university in time for the opening of the spring term.

DR. DALLAS B. PHEMISTER, professor and chairman of the department of surgery at the University of Chicago, will give the sixth E. Starr Judd lecture at the University of Minnesota on February 1. He will speak on the "Pathogenesis of Gallstones." The late E. Starr Judd, an alumnus of the Medical School of the University of Minnesota, established this annual lectureship in surgery a few years before his death.

LECTURES of the Royal College of Physicians were given during November as follows: The Bradshaw Lecture on "The Chemotherapy of Bacterial Infections," by Dr. Lionel Whitby; the Fitzpatrick Lectures on "Conquest of Disease in the Tropics," by Dr. Harold Scott, and the Lloyd Roberts Lecture on "Some Problems of Human Congenital Disease," by Professor J. B. S. Haldane.

THE subject of this year's Christmas lectures for young people at the Royal Institution, London, was "Young Chemists and Great Discoveries." They were given by Dr. James Kendall, professor of chemistry in the University of Edinburgh.

A CONFERENCE of national park superintendents and other administrative field officers of the National Park Service will be held in Washington, D. C., from January 5 to 10 in the new building of the Department of the Interior. Present methods of operating, developing and administering the various federal park areas will be studied, with a view to effecting all possible improvements for the benefit of the traveling public.

THE Association of Official Agricultural Chemists at its meeting in Washington in November voted to establish three awards of $300, $200 and $100 to be known as the Wiley Memorial Awards to perpetuate the memory of Harvey W. Wiley, who for years served the association as secretary and later as honorary president. *Industrial and Engineering Chemistry* states that the faculty of any accredited college or university in North America is privileged to submit from among its senior student body one competitive thesis, compilation or résumé on any one of the subjects dealt with in the several chapters of the association's book on "Methods and Analysis" and to nominate its candidate for the award to the committee of the Association of Official Agricultural Chemists, which will make the final selection. All contributions must be in the hands of W. W. Skinner, secretary of the Association of Official Agricultural Chemists, Box 540, Benjamin Franklin Station, Washington, D. C., on or before August 1.

As announced at the time of his death in 1937, Henry Dazian, a leading theatrical costumer, left the bulk of his estate to establish a foundation for research in medicine and the creation of medical fellowships. According to a recent transfer tax appraisal the sum of $1,325,288 will go to establish the foundation. Under the will a self-perpetuating board of five physicians and four laymen is designated to conduct the work of the foundation. Full power was left to the governing board to regulate the functions of the foundation and to direct distribution of its funds. Twenty-five years after his death, Mr. Dazian directed that the principal of the trust funds be distributed to hospitals, sanatoria and similar institutions selected by majority vote of the board. During the life of the trust, however, Mr. Dazian directed the board to create and maintain two fellowships, at not more than $2,500 yearly, for affording a post-graduate education to persons already holding a degree of doctor of medicine, so that they may specialize in some science directly or indirectly associated with medicine.

According to *Nature,* at a reception on December 6 at the Belgian embassy, Baron de Cartier de Marchienne, the ambassador, presented a number of bronze medals awarded by King Leopold of the Belgians to various British scientific workers. The medals, bearing on one side the head of King Leopold and on the other the name of the recipient, and the occasion of the award, were a token of appreciation for the help given by the various specialists in classifying the natural history collections which the King of the Belgians made in 1928–29 during his voyage to the East. The recipients, most of whom were present at the embassy, were: Sir Guy Marshall, Dr. K. Jordan, Dr. Isabella Gordon, Dr. S. Maulik, Dr. W. H. Leigh-Sharpe, Miss G. Ricardo, C. L. Collenette, Mrs. L. M. I. Macfadyn, W. H. T. Tams, H. E. Andrewes, Miss I. Meyrick (for her late father, Mr. E. Meyrick), Professor H. Gordon Jackson, Dr. H. Hanitsch, C. J. Arrow, Dr. Evelyn Cheesman, Dr. Marie V. Lebour, Dr. Schwarz, L. B. Prout, A. J. T. Janse and Lieutenant-Colonel F. C. Fraser.

The British Commonwealth Scientific Conference which met in London in 1936 recommended that an Imperial Bureau of Dairy Science should be established with headquarters at the National Institute for Research in Dairying, Shinfield. According to *The Lancet,* this recommendation has now been carried out and Professor H. D. Kay, D.Sc., director of the institute, has also been appointed director of the new bureau, while W. G. Sutton, from Massey Agricultural College, New Zealand, has been appointed deputy director. The bureau is financed cooperatively by the governments of the British Empire in the same way as the other imperial agricultural bureaus. The bureau will index research work in dairy science, and collect, abstract and collate information which it will distribute both by publication and by private communication to research workers, officials and advisory officers throughout the empire. Its ambit will include the microbiology, chemistry and physics of milk and its products; animal diseases in so far as they affect milk and its products; the technology of processing milk and manufacturing dairy products; the physiology of milk secretion as affecting quality and quantity of milk and dairy products; and standards for the composition and quality of milk and its products. The bureau will also promote conferences of workers and visits to research centers, and encourage the circulation of information, ideas, material and personnel.

It is reported in the *Journal* of the American Medical Association that the building of the Japanese institute for research in military aviation medicine, under construction since last summer on the top of Mount Fuji (3,778 meters), was completed in July. The opening ceremony was held in August, with many prominent military surgeons present. The costly building contains fourteen rooms with complete protection against cold, and it is situated next door to the station belonging to the Central Meteorologic Observatory. There will be a standing staff consisting of two army surgeons, and two men from the military medical school will alternate yearly as assistants. The chief research will be on such subjects as the physiologic state of the human body at a high altitude and the hygiene of aerial navigation. This is the first institution of this kind in Japan.

DISCUSSION

AN OUTWORN NOMENCLATURAL PRACTICE

The old dictum that "nomenclature is a means not an end" probably needs even more emphasis now than formerly. Always a practical matter, nomenclature in a practical age and one with vastly increased demands has little place for tradition unsupported by modern needs.

An ideal system of nomenclature and many of the details of its practice should meet the needs not only of working taxonomists and specialists, but, so far as possible, also of general zoologists, paleontologists, anthropologists and laymen. Doubtless the specialist should not unduly sacrifice his requirements for those of the layman, but any simplification which he can make tending toward the ideal is likely to be a forward step. It is idle to say that the layman should be disregarded entirely, for he is not sharply distinguishable and, as knowledge becomes more and more synthesized, he demands increasingly the privilege of using it, not only as to its generalizations but even as to its technique.

Established nomenclatural practices are not lightly to be changed. Most of them are the result of hard experience and, especially those written into official codes, are born of necessity and struggle. There appear to be some, however, that go back to a time when names were relatively few, that have never been the subject of controversy and that now persist after they have become burdens rather than advantages. One of these, to which attention may be called, is the practice of enclosing in parenthesis the authority for specific or subspecific names which have been transferred from one genus to another. To discontinue this would be a blessing to the active taxonomist, to whom it is now needless, and also to the layman, to whom the name itself is a sufficient irritation without this added esoteric source of mystification.

Apparently the first sanction for the use of the parenthesis is that found in the so-called Stricklandian code authorized by Section D of the British Association and published in 1842, nearly a century ago. Here there is lengthy discussion of the relative merits of first and second authorities with decision in favor of the first and recommendation that the authority for the specific name when not also that for the combination should be enclosed in parenthesis and followed by the symbol (sp.). The example given is "*Tyrannus crinitus* (Linn.) (sp.)," thus written. This obviously awkward arrangement is then followed by a footnote stating that "The expression *Tyrannus crinitus* (Linn.) would perhaps be preferable from its greater brevity." Double authorities seem not to have been considered at this early date and zoologists do not now use them. If any zoologists ever used them, the practice was soon discontinued. For botanists, who "worship the combination," as some one has said, the parentheses may be defensible; but zoologists, having dropped the second authority, should also drop the parentheses.

It is difficult to see much advantage in the parenthesis even as it was used by early authors when it was less called upon to indicate a changed combination than now. It merely drew attention to the fact of a change for any cause whatever and could not go farther as to the time, place or reason for such change. These details were to be found in the synonomy, and even there they were not always fully evident, so it was only the specialist in the group concerned who understood all the implications of the symbol. For him, therefore, it was likely to be superfluous, and for any one else its significance was almost or quite negligible. A name with its authority in parenthesis simply had a different history from that of one without it. It was not necessarily one that had a longer or more vicissitudinous history, since it was quite possible for a name to be changed and carry the parenthesis for a considerable period and then return to its original form, when the parenthesis would be omitted.

In the nineteenth century, when generic concepts were relatively static, the transfer of a species from one genus to another was an event which assumed an importance that can scarcely be claimed for it now. To signalize such a change may have had some advantages when the field was limited and before the tremendous expansion of knowledge and refinement of practice which has taken place in recent years. As every one knows, the species of Linnaeus is the genus of to-day with the result that the great majority of early nomenclatural combinations have been changed and there is no great need to point out each one individually.

The International Code of Zoological Nomenclature directs the use of the parenthesis only in cases involving changed generic and specific combinations. In spite of this, several rather prolific writers have assumed to use the parenthesis to indicate any change whatever from the form originally written, even though the generic term remains the same. Especially they have used it for names changed from binomials to trinomials, or *vice versa,* and, since such names often act as if on a pendulum, there is little accomplished except mental exercise. This, it seems to me, is compounding a felony. Probably some of them would not draw the line even at changes in spelling or capitalization.

Possibly there are some advantages in retaining the parentheses, but even so, they are greatly outweighed by the practical inconveniences. For a number of years my personal experience has engendered a growing antipathy to them. As a writer on taxonomic subjects, as an editor of taxonomic manuscripts, as a provider of popular printed matter and labels for a large museum and a zoological garden and as an adviser to amateur naturalists, I have found the parenthesis a constant source of irritation and loss of time. For some years I have ceased to use it on museum labels and am now spared the attempt to explain it to printers, proofreaders and public. Also in recent technical papers of my own it has been omitted. One of these[1] dealt with some 250 species and had a fairly wide distribution. After six years, no one has complained. Moreover, I have discussed the matter with various zoologists and do not find them inclined to offer defense unless on grounds of pure conservatism.

Typographically the parentheses are not desirable. They often mar the appearance of the printed page, and they are always anathema to the proofreader. Some amusing incidents have occurred. In one case, a very competent proofreader, finding some names with and some without parentheses, very carefully supplied the omissions and the change was not detected until final proofs were reviewed. In a very recent publication[2] the proofreader or editor completely triumphed. Here every one of nearly 150 authorities is carefully placed not in parentheses but in brackets, obviously without the knowledge or consent of the author.

Since the foregoing was written, I have read two recent communications to SCIENCE[3] discussing related subjects. Like Dr. Jacot, I agree with Mr. Peattie that single authorities are sufficient, and the fact that zoologists find them so seems pretty good evidence. However, it may be readily conceded that botanists at this time, having a different historical background, may wish to retain the double authorities for good reasons which do not apply in zoology. To change the single authority to the maker of the combination as advocated by Mr. Peattie would be highly impractical for zoologists at this late date. Some of the arguments he makes for it were discussed in the Stricklandian code of 1842, previously mentioned. Since then all the emphasis has been upon the original describer of the species, who has been thoroughly indexed and docketed, while the maker of the combination has been given scant recognition. In connection with Mr. Peattie's zoological example, it is fair to assume that the same authority which informed him that *Butorides virescens* is the current name for the green heron would also give him chapter and verse relative to the original Linnaean name *Ardea virescens*. This authority naturally would be the Checklist of the American Ornithologists' Union. In other words, it would be practically impossible for him to obtain the combination from a really authoritative source without also finding the original reference.

It may be that both botanical and zoological practices are due for great changes in the future; but unless zoologists are willing to make a beginning by such a change as dropping the superfluous parenthesis, it will be more than the hundred years suggested by Dr. Jacot before much progress is made.

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ESKIMO SEXUAL FUNCTIONS

WHITAKER, in his recent note on Eskimo sexual functions,[1] quotes some interesting data from Bertelsen[2] regarding the age at menarche among these people, and raises again the much discussed question as to the reliability of Dr. Cook's reported observations a half century ago.[3] Bertelsen now finds the age at menarche to be 15½ years, while a half century ago Dr. Cook stated that it occurred at the age of 19 or 20 years. And a century ago MacDairmid[4] said that the menses did not begin until about the age of 23 years. Because of the wide variance in these reports, must we discard the earlier ones as unreliable, and accept only the recent one based on carefully collected statistics? May there not have occurred among the Eskimos the same marked progression of the menarche toward earlier ages that has been witnessed in many other regions of the earth during the last century?

Original masses of statistics recently calculated by the author[5] gave mean ages at onset of the menses as follows:

Germany, Göttingen,	1795	16.6 years
Munich,	1864	16.3 "
Munich,	1880	15.4 "
Giesen,	1920	14.5 "
Norway,	1868	16.1 years
	1935	14.5 "
U. S. A., Cincinnati		
Age of Women (1935) (Years)		Mean Menarchial Age (Years)
24	under 20	13.13 ± 0.22
78	20–29	13.77 ± 0.11
125	30–39	14.09 ± 0.10
118	40–49	14.29 ± 0.11
97	50–59	14.75 ± 0.14
62	60–69	14.76 ± 0.14
48	70–79	14.67 ± 0.17
22	80–89	14.77 ± 0.34
1	91	in her 15th year.
Philippine Islands, Cebu (1935)		
64	under 20	14.48 ± 0.11
65	20–29	15.59 + 0.14
76	30 +	15.71 ± 0.11

Similar findings have been obtained from many countries and from different races, always showing a progressively earlier onset of the menses. Girls entering the Universities of Cincinnati, Southern California and Wisconsin have exhibited a reduction of menarchial age from over 14 years for those born before 1900, down almost to an even 13 years for those born in 1918. This march toward ever earlier menarchial age *seems to be a world-wide phenomenon no longer subject to question.*

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[1] *Field Mus. Zool. Ser.*, 18: 193–339, August, 1932.

[2] Dixon, "Birds and Mammals of Mount McKinley National Park," U. S. Department of the Interior, National Park Service, Fauna Series, No. 3, 1938.

[3] Peattie, SCIENCE, 88: 128, August 5, 1938; and Jacot, 88: 240, September 9, 1938.

[1] Wayne L. Whitaker, SCIENCE, 88: 214, 1938.

[2] A. Bertelsen, *Meddelelser om Grønland*, Bd. 117: nr. 1, 1935.

[3] F. A. Cook, *Trans. N. Y. Obstet. Soc.*, 1893–4.

[4] E. M. Weyer, "The Eskimos," p. 48, 1932.

[5] C. A. Mills, *Human Biology*, 9: 43, 1937.

The earlier development of menstrual functions has been accompanied by a steady and marked improvement in growth and adult stature, an improvement found in practically every population mass for which growth statistics have been examined in recent years. In animals, also, it has been pretty well established that the time of onset of sexual functions is determined more by the stage of physical development than by chronologic age. More rapid growth in animals, as in girls, is associated with earlier onset of sexual functions.[5, 6, 7, 8] The change in menarchial age so universally observed in many countries and races may therefore well be regarded as only one phase of the general world-wide quickening and improvement in the physical development of man.

In the light of this more general view of the facts available, would it not perhaps be better to place more reliance on the observations of *MacDairmid and Cook*, even though they are unsupported by actual statistics? It may be that the menarchial age for these Eskimos did change from nineteen down to fifteen and a half years during the last half century. Such would be an 18 per cent. reduction, as against the 11 per cent. witnessed in Germany up to 1920.

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ERYTHROCYTES OF SLOTH

IN a recent article appearing in SCIENCE,[1] entitled "Elliptical Erythrocytes," Dr. M. C. Terry has expressed hope "that some one who is in a position to do so will tell us who is right about the erythrocytes of the sloth." The point in question concerns the actual shape of the erythrocytes.

During the past year while a research fellow in the laboratory of histology under Dr. H. E. Jordan, we had an opportunity to study the blood elements of the two-toed Panamanian sloth (*Choloepus hoffmanni*). A number of these animals had been secured and transported to Virginia for study by Dr. S. W. Britton, who in turn furnished us with material for future investigations.

Study of freshly drawn blood, blood smears and bone marrow smears has reassured us that Jordan was correct in his statement that "among mammals the shape of the red blood corpuscles is uniformly that of a circular biconcave disk, except in the Camelidae, where these elements have an elliptical shape." In smear preparations of blood, as well as in stained sections of various tissues of the sloth, erythrocytes are frequently distorted, while many of the less distorted ones present an elliptical shape. In blood smears of both the cat and rat, similarly distorted erythrocytes having an elliptical shape are frequently observed. Any deviation from the circular shape of red blood corpuscles among these animals, as observed in prepared material, is unquestionably due to external factors.

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SCIENCE IN THE OLD SOUTH

IN an article entitled "Science and Society in Ancient Rome," Dr. William Salant[1] in advancing the view that society determines the growth or the decline of science, states: "As Kofoid[2] pointed out in a recent article, science worthy of the name scarcely existed in the South before slavery was abolished."

Dr. Kofoid's article is a review of a book entitled "Scientific Interests in the Old South," by Dr. Thomas Cary Johnson, Jr., associate professor of history in the University of Virginia. Dr. Kofoid states: "The author's theme is the *refutation of the summary indictment* of Morrison in 'The Oxford History of the United States,' volume 2, page 15, of the 'non-existent intellectual life' of the South, due to the cultivation of cotton, the neglect of men and the blight of slavery. *The data assembled support his defence,* for they display a wide-spread and active interest in the physical, chemical and medical fields, and a considerable though desultory activity in the natural sciences." (Italics mine).

Among the little-known facts brought out by Professor Johnson are the following: William Barton Rogers, founder and first president of the Massachusetts Institute of Technology, which opened its doors to students (including women) in 1865, succeeded his father, P. K. Rogers, in 1829 as professor of natural philosophy and chemistry at William and Mary College, and from 1835 to 1853 served as professor of natural philosophy and geology at the University of Virginia. On December 11, 1787, James Rumsey of Virginia ran a steamboat of his own invention against the current of the Potomac River at a speed of four miles per hour. Cyrus McCormick, of Pocahontas County (then in Virginia), invented, made and sold his reaper on his father's farm there from 1839 to 1844. Immediately following the opening of the Baltimore and Ohio's first division in 1830, came the Charleston-Hamburg (S. C.) line, with the *Best Friend of Charleston*, the first locomotive made in America for

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[6] Carl G. Hartman, SCIENCE, 74: 226, 1931.

[7] Frank K. Shuttleworth, Monographs of the Society for Research in Child Development, National Research Council, Vol. II, No. 5 (Serial No. 12), Washington, 1937.

[8] Cordelia Ogle, *Amer. Jour. Physiol.*, 107: 628, 1934.

[1] SCIENCE, 88: 475, November 18, 1938.

[1] *The Scientific Monthly*, December, 1938.

[2] SCIENCE, 88: 109, 1938.

regular and practical use. "Maury of Virginia, pondering the results of deep-sea soundings, discovered the Atlantic plateau and suggested the Atlantic cable to Cyrus Field." Among the many other Southern scientists mentioned by Professor Johnson are J. Lawrence Smith, John James Audubon, H. W. Ravenel, John W. Mallet, F. P. Venable, Lewis R. Gibbes, Wm. C. Wells, John and Joseph Le Conte. The National Museum Report (Washington, 1897) links Thomas Jefferson with Agassiz as having done so much for science in America, mainly by the immense weight given science by their advocacy.

It seems to me that any unprejudiced person, looking through this book and considering the facts about the South, will agree that Dr. Salant's sweeping statement is unwarranted. Perhaps he was misled by what Dr. Kofoid said in commenting on the *arrangement* of the subject-matter of the book: "Details of evidence of educational interest abound, but a synthesis of accomplishment in the several disciplines is not achieved. There is a noticeable absence of evidence of sustained activity by productive investigators in scientific fields."

For a number of years past I have been trying to accumulate data as to what scientists of the South did to aid the Confederacy in the face of a stringent blockade. The sunken Merrimack was raised and converted into an ironclad, the Virginia. The Charleston submarine, Little David, repeatedly went down with all hands, only to be raised again to damage a Federal ship before her last plunge. The gunpowder made by Colonel Rains was so excellent that what was left after the war was used in the gunnery school at Fortress Monroe and was declared by a British officer to be equal to the best British powder. I will welcome any data showing what scientists did for the Confederacy.

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SCIENTIFIC BOOKS

CRYPTOGAMIC BOTANY

Cryptogamic Botany. BY GILBERT M. SMITH. Vol. I, $4.00; Vol. II, $3.00. McGraw-Hill, 1938.

ANY thorough-going review of G. M. Smith's "Cryptogamic Botany" would require that each of the several sections of the two volumes be separately considered by a specialist in the field concerned. With the first volume dealing with algae and fungi and the second with bryophytes and pteridophytes, the author has covered so wide a field that a critical appraisal of all the diverse parts would demand the services of a phycologist, a mycologist, *et al.* It is certain, however, that this work is of major importance in the general field of plant morphology and phylogeny, both because it does cover so extensive a field, because of the scholarly quality and workmanship, and because it represents an attack on general problems in plant science which have received far too little attention. Without attempting to be thorough in any particular field, the present reviewer would like to call attention to certain aspects and implications from the standpoint of a biology teacher.

What is meant by the standpoint of a biology teacher may perhaps deserve some definition. While it is still broadly true, as noted by Thaxter some years back, that most "biologists" are zoologists who teach something about plants in courses and text-books designated as "biological," there are a number of "biologists," like this reviewer, whose antecedents are botanical, and some biology texts which have joint zoological and botanical authorship. Without any definite figures as support, the opinion is ventured that the vast majority of students make their first acquaintance with organized plant and animal science in biology courses and biology texts. Long experience in such courses, with a total approaching fifteen thousand students, makes this reviewer certain that there is such a thing as a "biological" point of view, even if no more is granted to biology courses than the success of a foundling cowbird, that of survival and multiplication.

The term "biology," first used by Lamarck and Treviranus in 1800, was coined to give expression to the idea of the essential unity of plant and animal phenomena, of which these men, whose work was biological in the truest sense, had gained some preliminary appreciation. Verified in the succeeding century, through the cell and protoplasm doctrines, through evolution and genetics, and through the physico-chemical analysis of living things, the implications of the broadest biological point of view are still often misunderstood. Too often, a biology course may mean an introduction to plant structure in terms of possible "dorsi-ventrality," or to plant functioning in terms of an assumed "physiological gradient"—in other words, on the kind of analogical reasoning basis by which Aristotle and Cesalpino interpreted plant structures and activity from their acquaintance with animals. The converse is sometimes true, when terms, exactly applicable only in a restricted botanical sense, like tropism, are applied in the zoological field to a wide diversity of different phenomena, as H. S. Jennings has pointed out.

In a general biological sense, the Smith text is important because it represents one of few attempts on the part of botanists to place plant classification on a broad phylogenetic basis. When a biology teacher attempts to place before his students, on a comparable basis, pictures of the plant and animal kingdoms and their subdivisions, he finds that zoologists have proceeded much further in dividing the animal kingdom into well-demarked, commonly accepted groups than have the botanists. First of all, he runs across the difference in terminology; the plant kingdom is divided into "divisions"; the animal kingdom into "phyla." "Division" is, of course, orthodox botanical usage, written down in the code of the Fifth International Botanical Congress of 1930, and followed practically exclusively in botanical writings, except by those rare plant biologists, like C. E. Bessey and J. H. Schaffner, who have been interested in delimiting the "phyla" of the plant kingdom.

While, scientifically, this difference in terminology may be considered trivial, the question is raised here whether there may not also be an unsuspected biological significance as well. Is it not a fact that the word "phylum" is much more appropriately applied to the subdivisions of the animal kingdom? That zoologists have really succeeded in recognizing and defining genetically determined phyletic groups, while botanists have been satisfied to go along with such catch-all congeries as "Thallophytes," a group which may be compared in content to the whole animal subkingdom of invertebrates?

That botanists have been slower in analyzing the plant kingdom into natural, more or less coordinate "phyla" has several possible explanations. The problem is vastly more difficult, the basis of subdivision less obvious, requiring biochemical discriminations of pigments, reserve food storage, etc., instead of the more obvious structural features by which animal phyla are separable. Moreover, it seems certain that in plants unicellular types will be found in several well-differentiated phyletic groups, while all one-celled animals are comprised in a single phylum. In the most critically difficult fields, of phycology and mycology, a great amount of pioneer work is still needed; botanists are still concerned with intensive studies, and, so far as fungi are concerned, the emphasis is chiefly economic. Even with the vascular plants, it is only within the past forty years that the anatomical and paleontological groundwork upon which a phyletic grouping may rest, has been accomplished.

"Acceptance of the view that various series of algae are more or less independent of each other means that both the Thallophyta and its subdivision Algae must be abandoned as natural units in classifying plants." From this premise, Professor Smith proceeds to carve nine phyletic groups out of the heterogeneous Thallophyta: Chlorophyta, grass-green algae; Euglenophyta, euglenoids; Pyrrophyta, cryptomonads and dinoflagellates; Chrysophta, the yellow-green algae (diatoms, etc.); Phaeophyta, or brown algae; Cyanophyta, blue-green algae; Rhodophyta, red algae; Myxothallophyta, slime molds; and Eumycetes, or fungi. The subdivision of the true algal groups follows lines which have been more or less anticipated by other writers, like Tilden, and is based upon the biochemical studies of men like Willstätter, etc. It is surprising to find no acceptance of the widely held opinion that the fungi themselves are *polyphyletic*, and that some fungi have real genetic relationships with certain algal groups. Bacteria are not included in the classification.

With his opinion that the higher vascular plants have been derived from Bryophyta, Dr. Smith recognizes that a majority of botanists will disagree. On the other hand, it is suggested here that while the great majority of general texts in botany are in agreement with Smith in keeping Pteridophyta and Spermatophyta as distinct phyla, the weight of evidence from plant anatomy and morphology and from paleobotany of the last forty years is preponderant for the conclusion expressed by Eames recently ("Vascular Plants. 1936"): "Seed habit can not be used to separate the vascular cryptogams from the phanerogams because of seeds found on the ancient group of fern-like plants." In other words, while the thallophyte miscellany has been long in need of subdivision, two other plant "divisions," Pteriodophyta and Spermatophyta, may just as reasonably be joined to form the Tracheophyta.

Finally, the importance of working toward a natural system of subdividing the plant kingdom is urged upon the authors of botanical texts and also on "botanical biologists." Such a division of Thallophyta as is presented by Smith is a distinct step in advance of present practice. It is not really more difficult to treat of nine phyletic divisions of the plant kingdom than to keep Thallophyta and then discuss its nine subdivisions.

R. C. BENEDICT

BROOKLYN COLLEGE AND
BROOKLYN BOTANIC GARDEN

SOCIETIES AND MEETINGS

THE TENNESSEE ACADEMY OF SCIENCE

THE forty-second meeting of the Tennessee Academy of Science was held at Vanderbilt University on November 25 and 26, 1938. The first general session was on Friday morning from 9 o'clock to noon, President Jesse M. Shaver presiding. Friday afternoon sectional meetings were held, with Dr. Philip Rudnick chairman for physics, Dr. L. C. Glenn for geology and Dr. H. M. Jennison for botany. At the academy dinner on Friday evening Dr. George R. Mayfield, of Vanderbilt University, was toastmaster, President Shaver made an address on the subject, "How to make a Great Man," and Professor D. M. Brown, of the State Teachers College, Johnson City, presented a moving picture of "Rhododendron Gardens of Roan Mountain." On Saturday morning the second general session was held, Vice-President Aaron W. Dicus presiding, and the reading of papers was resumed. Classification of the papers on the program shows fourteen from two universities, ten from three colleges for teachers, eight from other schools, nine from federal and state organizations, and three from other sources.

On adjournment at 12 o'clock, Saturday, President Shaver called the members to order for the annual business meeting. The report of the secretary showed the membership practically the same as one year ago—430, including 69 fellows and 34 annual members of the American Association for the Advancement of Science. The appointment of a boy and girl from science clubs in the state for annual honorary junior membership in the association was placed in the hands of the executive committee. A resolution was adopted thanking Governor Gordon Browning for his efforts in the line of state conservation during the past two years and requesting Governor-elect Prentice Cooper to continue the work under his administration. Nineteen applicants were elected to membership in the academy. Officers elected for the year 1938–39 were:

President, Aaron W. Dicus, Tennessee Polytechnic Institute, Cookeville.

Vice-President, William M. Mebane, State Teachers College, Murfreesboro.

Secretary-Treasurer, John T. McGill, Vanderbilt University.

Officers of the Sections: Botany—*Chairman*, George R. Gage, Vanderbilt University, and *Secretary*, Chester P. Freeman, State Teachers College, Memphis; Geology—*Chairman*, George M. Hall, University of Tennessee, Knoxville, and *Secretary*, Kendall E. Born, Department of Geology, Nashville; Physics—*Co-chairmen*, Kenneth E. Hertel, University of Tennessee, Knoxville, and Newton Underwood, Vanderbilt University.

The 1939 spring meeting of the academy will probably be at some point in West Tennessee, the locality and date to be fixed by the executive committee.

John T. McGill,
Secretary

THE INDIANA ACADEMY OF SCIENCE

The fifty-fourth annual meeting of the Indiana Academy of Science was held at West Lafayette, Indiana, on November 3, 4 and 5, 1938, with Purdue University as host, and President Eli Lilly, of Indianapolis, in active charge. The first general session was largely devoted to honoring Dr. Joseph Charles Arthur and Dr. Stanley Coulter, both emeritus professors of Purdue University and former presidents of the academy. Dr. Frank D. Kern, dean of the Graduate School, Pennsylvania State College, paid tribute to Dr. Arthur in an address, "The Life and Work of Joseph Charles Arthur," and Dr. Ray C. Friesner, Butler University, honored Dr. Coulter with "A Tribute to Dean Stanley Coulter."

A total of 29 papers was presented at the general meetings and the nine divisional meetings. The attendance at these meetings was 450. Special action was taken by the academy to put into operation at the next annual meeting the plan for giving honorable mention to the authors of outstanding papers presented at the meeting

The annual dinner meeting was attended by 250, following which President Lilly gave his president's address on "A Plan for Accomplishing More Effective Research." The officers chosen for 1939 are: T. G. Yuncker, DePauw University, *President*; Louis A. Test, Purdue University, *Vice-President*; William P. Allyn, Indiana State Teachers College, *Secretary*; William P. Morgan, Indiana Central College, *Treasurer*; Paul Weatherwax, Indiana University, *Editor of the Proceedings*; Will E. Edington, DePauw University, *Press Secretary*. The divisional chairmen for 1939 are: Paul Weer, Indianapolis, Archeology; W. A. Jamieson, Indianapolis, Bacteriology; Winona Welch, DePauw University, Botany; Herman T. Briscoe, Indiana University, Chemistry; Thomas M. Bushnell, Purdue University, Geology and Geography; P. D. Edwards, Ball State Teachers College, Mathematics; R. B. Abbott, Purdue University, Physics; F. B. Knight, Purdue University, Psychology; C. P. Hickman, DePauw University, Zoology.

The entomologists and taxonomists of the state held their meetings on Saturday, the latter group conducting a symposium on "The Concept of the Species."

The Junior Academy of Science also held its meetings on Saturday with an attendance of 250, representing forty high-school science clubs. A number of exhibits and demonstrations of the work of the high-school science clubs of the state was shown and also nine papers were read. Dean Howard E. Enders, Purdue University, is academy sponsor for the Junior Academy.

Will E. Edington,
Press Secretary.

SPECIAL ARTICLES

THE SHAPE OF THE CHICK EMBRYO GROWTH CURVE[1]

MURRAY[2] has found that the logarithm of the chick embryo weight when plotted against the logarithm of age yields a straight line from 5 to 19 days of age. Although he did not attach any significance to this observation, some of the later investigators, who apparently have confirmed Murray's finding, have on basis of it elaborated several different hypotheses regarding the nature of the growth process. Needham[3] in his exhaustive treatise on chemical embryology reviewed these adequately, and it is not necessary for the purpose of this note to reiterate any of them. It may be, however, mentioned that a recent generalization of the laws of growth (Glaser[4]) also utilizes Murray's observation.

It is obvious that, if chick embryo growth conforms to a single logarithmic straight line throughout the embryonic period, far-reaching consequences for generalized descriptions of the growth process may ensue. It is therefore exceedingly important to determine the validity of describing the total chick embryo growth by means of such a straight line.

In preparing a logarithmic plot of unpublished data from this laboratory, it was noted that while an excellent straight line fit was obtained for the portion of the growth curve from 7 to 12 days of age, a flexure was noted at about 12 days. The observed weights rose above the calculated ones, the difference between the two gradually disappearing towards the end of the embryonic life of the chick.

Fortunately, Needham (Appendix I, Table 3) lists a number of sets of embryo weights obtained by various investigators, thus affording an opportunity to examine these sets for similar deviations. The more complete sets comprising the data of Falck, Hasselbach (two sets), Bohr and Hasselbach, Lamson and Edmond, Iljin, Schmalhausen (two sets), Henderson and Brody, Romanoff, and Byerly (loc. of all cited by Needham) were thus utilized. Murray's data were obtained from his original paper, since Needham cites the calculated rather than the observed figures. In addition the data presented by Landauer[5] for normal embryos and the data from this laboratory[6] were used.

The procedure was to obtain the least squares fit to the straight line

$$\log w = a \log t + b$$

for each of the sets for the period from 7 to 12 days of age. If the straight line fit is legitimate for the whole of the embryonic growth period, the equation obtained on basis of these six points should apply equally well to the period from 12 to 20 days. Calculated logarithms of weights for each age from 7 to 20 days were then obtained and the deviations from the observed logarithms of weights computed. In each case the origin of the deviations may be considered as the straight line resulting from a plot of calculated log weights against themselves. The slope of this line is equal to unity in all the sets. This permits calculation of the mean deviation with its standard error for each day of incubation.

It should be noted that the first four sets cited were recorded in 1900 and earlier. The conditions of incubation under which the embryos were grown were probably not optimum, since great advances in incubation technique have been made since that time. This fact would undoubtedly tend to distort the normal progress of growth, and because of it computations are presented both including and excluding these four sets. Thus for the first computation 14 sets of data were used, while for the second only 10. These numbers varied somewhat, since not all ages are represented in all the sets of data.

Table 1 presents the mean deviations for each age.

TABLE 1
DEVIATION OF OBSERVED FROM CALCULATED LOGARITHMS OF EMBRYO WEIGHT

	All data (14 sets)		Data since 1900 (10 sets)	
Age	Mean deviation	Dev./S.E.	Mean deviation	Dev./S.E.
7 ..	.0009 ± .0057	.16	–.0006 ± .0055	.11
8 ..	.0036 ± .0088	.41	.0038 ± .0050	.76
9 ..	.0003 ± 0108	.03	.0046 ± .0115	.40
10 ..	.0076 ± .0096	.79	.0014 ± .0063	.22
11 ..	–.0049 ± .0132	.37	–.0053 ± .0121	.44
12 ..	–.0144 ± .0062	2.32	–.0066 ± .0044	1.50
13 ..	.0231 ± .0143	1.62	.0424 ± .0102	4.16
14 ..	.0376 ± .0133	2.83	.0527 ± .0112	4.71
15 ..	.0290 ± .0175	1.66	.0500 ± .0115	4.35
16 ..	.0278 ± .0201	1.38	.0468 ± .0173	2.71
17 ..	.0108 ± .0217	.50	.0405 ± .0157	2.58
18 ..	–.0075 ± .0268	.28	.0242 ± .0253	.96
19 ..	.0075 ± .0224	.33	.0169 ± .0225	.75
20 ..	.0061 ± .0270	.23	.0104 ± .0298	.35

The first series of computations indicate significant deviations only at 12 and at 14 days of age. It is, however, the second series that brings out the fact that the deviations observed originally in the data from this laboratory were not chance fluctuations. There appears to be a sharp acceleration in the observed growth at 13 days of age. The discrepancies between the observed and calculated logarithms of embryo weight rise to a maximum at 14 days and then gradually decrease until they lose their statistical significance at 18 days of age. There remains but little doubt of the reality of these deviations, and the conclusion that a single straight line does not fit the whole period of embryonic growth seems unescapable.

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[1] Assistance in computations was provided under WPA project A. P. No. 465-03-3-209.

[2] H. A. Murray, Jr., *Jour. Gen. Physiol.*, 9: 39, 1925.

[3] J. Needham, "Chemical Embryology," 3 vols. Cambridge University Press, 1931.

[4] O. Glaser, *Biol. Rev.*, 13: 20, 1938.

[5] W. Landauer, *Storrs Agr. Exp. Sta. Bull.*, 193, 1934.

[6] I. M. Lerner and C. A. Gunns. Unpublished, 1938.

It is of interest to note that a similar picture prevails in embryos incubated under the high temperature of 105° F. as revealed by similar computations involving the data of Henderson and Brody.[7] However, here the acceleration occurs at an earlier stage, which is, perhaps, in keeping with the usual temperature effects on rates of processes. The fragmentary data of the same workers on embryos incubated at 95° F. reveal a complete distortion of the logarithmic straight line. These observations lend support to the legitimacy of disregarding the data of the earlier workers.

The significance of the finding here reported undoubtedly needs further elaboration and explanation in biochemical terms. Thus the curve of log dry weight plotted against log time, presented graphically by Glaser from Murray's[8] data, shows a very pronounced flexure of the same type as observed here. The differentiation of energy sources during the course of embryonic growth (Needham, p. 992) may also be recalled in this connection, as may also fluctuations in glutathione concentration (Gregory, Asmundson and Goss[9]).

The purpose of this note, however, is limited to drawing attention to the fact that while individual sets of data may produce a satisfactory fit to the logarithmic straight line, small deviations in the same direction and appearing at the same time in the majority of sets of reliable data can not be disregarded. Cognizance of this situation is commended to workers in the field of embryonic growth.

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THE ROLE OF HEREDITY VERSUS ENVIRONMENT IN LIMB BUD TRANSPLANTS BETWEEN DIFFERENT BREEDS OF FOWL

USING the technique developed by Hamburger,[1] the author has transplanted 60- to 70-hour White Leghorn limb buds into the coelome of Brown Leghorn hosts of the same age. The host embryos were then allowed to develop until 15 or more days of age. Two different types of results have been obtained. In seven cases in which the grafts became attached to the mesenteries, a normal White Leghorn leg developed upon the Brown Leghorn host. The feathers of the transplant were white, and the scales on the shank and foot were characteristically pigmented. The White Leghorn graft, therefore, differentiated according to its hereditary potentialities. The environment, in these cases, seemed to have had no influence.

These results are at variance with those of Willier and his co-workers, who have reported[2] that White Leghorn limb buds developed colored plumage when grafted to colored breeds. Two grafts, however, have been obtained which seem to clarify this discrepancy. In one case the graft possessed Brown Leghorn feathers and the scales of the shank were pigmented, while the foot had yellow scales typical of the White Leghorn. In this instance environmental influences have been able to suppress, almost completely, the hereditary potentialities of the graft. In another the upper part of the leg was covered with brown feathers, the lower portion with white, and the shank and foot were unpigmented. This case, therefore, was an intergrade. Both these latter grafts were exceedingly well attached to the inner body wall.

These results indicate that White Leghorn plumage develops on grafts which are attached to the mesenteries and that Brown Leghorn plumage occurs on grafts that are attached to the body wall. It is possible that the results may be explained on the basis of a diffusion gradient between host and graft. If the graft is well attached to the host and an enzyme or "color-inducing substance" reaches the transplant in sufficient amounts, the hereditary potentialities of the graft are suppressed completely and the transplant develops the plumage and pigmentation characteristic of the host. If the attachment is less secure and a smaller amount of color-inducing substance reaches the graft, an intergrade results. In cases where little or no enzyme diffuses into the graft, a typical White Leghorn leg develops on the brown host. A further analysis of this problem is in progress.

In reciprocal transplants, Brown Leghorn limb buds transplanted to White Leghorn hosts, three different types of results were obtained. In several cases typical Brown Leghorn feathers developed upon the transplanted limb, and the shank and foot possessed the typical pigmentation of the Brown Leghorn. These results confirm the findings of Willier, who obtained similar results with skin grafts. In three cases the environment has suppressed, or at least retarded, the development of the brown feathers since 15-day-old transplants possessed all white feathers or else only a few feathers were pigmented.

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[7] E. W. Henderson and S. Brody, *Mo. Agr. Exp. Sta. Res. Bull.*, 99, 1927.

[8] H. A. Murray, Jr., *Jour. Gen. Physiol.*, 9: 405, 1926.

[9] P. W. Gregory, V. S. Asmundson and H. Goss, *Jour. Exp. Zool.*, 73: 263, 1936.

[1] Viktor Hamburger, *Jour. Exp. Zool.*, 77: 379–399, 1938.

[2] B. H. Willier, Mary E. Rawles and E. Hadorn, *Proc. Nat. Acad. Sci.*, 23: 542–546, 1937.

In one fifteen-and-one-half-day transplant which was attached to the mesenteries of the host, the outer portion of the graft was covered with brown feathers, the inner portion possessed white plumage, and the characteristic brown pigment was lacking in the lower leg and foot. Furthermore, typical Brown Leghorn feathers covered the greater portion of the right wing of the host. Although this latter condition may have been due to a somatic variation, Dr. Harry L. Kempster, professor of poultry husbandry at the University of Missouri, joins me in the view that the pigmentation of the wing feathers has been induced by the graft. This case seems to indicate a mutual interaction between the host and transplant or between the hereditary constitution and the environment.

A diffusion gradient apparently does not explain these latter cases, since some well-attached grafts developed colored plumage and other less well-attached transplants possessed white feathers. Experiments are in progress which may shed additional light on the problem.

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NEW OBSERVATIONS ON THE EFFECTS OF CALCIUM DEPRIVATION[1]

THE authors have observed that a profound neurological disturbance develops in growing rats maintained on diets very low in calcium (0.01 to 0.02 per cent.) which has heretofore not been associated with a deficiency of calcium. The neurological picture, which is quite complex, is suggestive of a diffuse lesion involving the cortex, basal ganglia, spinal cord and peripheral nerves.

The nervous condition is best demonstrated by subjecting the experimental animals to short and mild galvanic shocks from an induction coil after they have been on the low calcium ration for six weeks or more. This stimulus causes the rats to collapse. The rats remain conscious, but they respond poorly and sluggishly to all stimuli. They show little ability to right themselves or to grasp objects with their paws. The fore limbs remain relatively normal, but there is always a paralytic foot drop of one or both hind limbs. Immediately after the onset of the collapse, the tail becomes anesthetic, while the head and trunk appear to be hyperesthetic. After a lapse of about 24 hours, the head and trunk also become anesthetic. The normal propulsive locomotion of these animals is greatly altered, and they generally show a retropulsive response which is not observed in the normal rat.

The effects of the disturbance appear to be reversible. The degree of prostration increases the longer the animals are kept on the calcium deficient diet. Severely depleted animals remain in a state of prostration for long periods of time and, as a result, usually die of inanition. Less severely deficient animals recover from the prostration after a varying period of time, even if they are still kept on the low calcium ration. Recovery, however, is hastened by feeding the control diet to the injured animals.

A condition similar to that which is induced by the galvanic stimulus may develop spontaneously in animals that have been maintained on the experimental diet for a period of from 9 to 14 weeks. The effect of the spontaneous collapse is very severe and the animals usually die within a few days.

Visible hemorrhage occurs frequently. In the central nervous system it has been observed in the cerebrum, spinal cord and the circle of Willis. This finding suggests that the neurological disturbance may well be a secondary effect of the vascular pathology. Hemorrhagic areas also have been noted in the lungs, gastrointestinal tract, bladder, bone and in the muscles of the gluteal region.

Chemically, the calcium deficient animals exhibit a low blood calcium, which was found to vary from 4.4 to 6.6 mg per 100 ml of serum.

Tetany does not occur in animals when merely reared on the low calcium rations. Tetany can be induced in thyro-parathyroidectomized rats by placing them on the low calcium diet. It takes 4 to 6 weeks to develop on this regimen. The tetanic spasms can be induced with a galvanic shock or, even better, with the hissing sound from an air jet.

Another point of considerable interest is that, although the bony skeleton is almost completely decalcified, the teeth appear to be relatively well calcified.

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[1] Aided by grants from the Rockefeller Foundation and the Christine Breon Fund of the University of California Medical School.

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MATHEMATICIANS, AND POETRY AND DRAMA[1]

By Professor RAYMOND CLARE ARCHIBALD
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IN general reading for a number of years I have been interested in accumulating information concerning, firstly, those who had not only achieved something noteworthy in mathematics but had also written verses or dramas; secondly, poems about mathematicians; and thirdly, the numerous incidental citations of mathematicians in poetry by poets of more or less distinction. Such general reading has not been confined to any one language, and translations of poetical or dramatic work of mathematicians were within the scope of my search. The large amount of material collected is in more than a score of languages, from the time of Pythagoras and his "Golden Verses"[2] down to the present. It is my purpose to give you some idea of the nature of this material. I am not aware that any one else has previously discussed this general theme.

The relations between poetry and mathematics have been considered by a number of writers;[3] but this is not really a part of my topic, and I shall dismiss it after quoting a single paragraph from "My Friend the Mathematician," written more than fifty years ago by Percival Lowell, in a book on Korea.[4] This paragraph thus treats one of many phases of the subject:

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[1] Address of the retiring vice-president and chairman of Section L (Historical and Philological Sciences), American Association for the Advancement of Science, delivered at a joint meeting of Sections A and L, of the American Mathematical Society and of the Mathematical Association of America; illustrated by 22 lantern slides. Richmond, Va., December 28, 1938.

[2] See, *e.g.*, "The Life of Pythagoras, with his Symbols and Golden Verses together with the Life of Hierocles, and his Commentaries upon the Verses. Collected out of the choicest manuscripts and translated into French, with annotations. By M. Dacier. Now done into English. The Golden Verses translated from the Greek," by N. Rowe. London, 1707. Greek text and Rowe's translation, pp. 149–164 + i–xj. "Pythagoras," a play by Martin Slaughter, was first acted in London in 1596.

[3] E. J. Wilczynski, "Poetry and Mathematics," *The University Chronicle*, 3: 191–204, 1900; read at the annual meeting of the Science Association May 2, 1900. I. Ionescu, "Matematica si poezia," *Gazeta Matematica*, 17: "Suppliment," pp. 1–3, May 15, 1912. D. E. Smith, (a) "Mathematics and Poetry," Florence, 1922, 8 pp.; (b) "Poetry of Mathematics," *Mathematics Teacher*, 19: 291–296, 1926; (c) "The Poetry of Mathematics and other Essays," New York, 1934, "The Poetry of Mathematics," pp. 1–13; contains practically all of (a). S.

> It has often been said that Poetry and Mathematics are own sisters. They differ in feature, but not in blood; and their common mother is Imagination. The saying will soon lose, if it has not already lost, the brilliant glitter of a seeming paradox, but only to be recognized with all the more distinctness as a truism. For art is to the senses what science is to thought, and both have their birth in the realms of fancy. To appreciate the one the senses must be acute, to understand the other the mind must be discerning; but to originate in either, this is truly dependent upon imagination in science as in art. The faculty has to do with thought pictures there, with sense creations here; but in both the creative idea comes from without the man himself. It comes suddenly upon him, as the flame, on relighting a candle that still is warm, appears to fall to the wick from the air above it. But the wick must be warm, the mind prepared or the spark never kindles.

Let us then consider some of those whose minds were prepared and on whom the flame descended. By way of illustration, I shall refer to at least a score of mathematicians who flourished during the past 2,200 years, in seven countries, and I shall try to suggest (to those of you who are not mathematicians) why most of them may be regarded as having achieved something of importance in mathematics, as well as what may be their connections with poetry or drama. Let us first of all turn to a group of Americans.

One of the leading research mathematicians of America at the present time, one who has been the recipient of more numerous international distinctions than any other, is George David Birkhoff (1884–), of Harvard University. After thirty years of meditation on the matter he published a book, in which he sought to bring the basic side of art, including music and poetry, within the purview of the simple mathematical formula defining "Aesthetic Measure," which is the title of his book.[5] There is a twenty-page chapter on "The musical quality of poetry," in which among other things the following topics are discussed: "The tripartite nature of verse" (that is significance, musical quality and meter), "The musical quality in poetry," "rhyme," "assonance," "alliteration," "the musical vowel sounds," "Poe's concept of verse," "poetry in other languages" and "the rôle of musical quality in poetry." He gives also an excellent "experimental poem" with his aesthetic measure indicated. It is as follows:

VISION

Wind and wind the wisps of fire
Bits of knowledge, heart's desire;
Soon within the central ball
Fiery vision will enthrall.

Wind too long, or strip the sphere
See the vision disappear.

Let us now consider another Harvard man, Thomas Hill[6] (1818–1891), president of the university for the six years 1862–68, immediately preceding President Eliot's régime. Among his books were the following mathematical works (1848–1887): "Elementary Treatise on Arithmetic," "Puzzles to Teach Geometry," "Geometry and Faith" (three editions), "An Elementary Treatise on Curvature." Also "A Fragmentary Essay on Curves" and (in collaboration with G. A. Wentworth) "A Practical Arithmetic." He invented the "occultator," an instrument for calculating eclipses and occultations, and a mechanical apparatus for determining latitude and longitude at sea. Now as to poetical contributions. In his senior year at Harvard he published a 16-page pamphlet, "Christmas, and Poems on Slavery."[7] Forty-five years later 120 of his poems, translations and imitations were brought together in a volume entitled "In the Woods, and Elsewhere."[8] His poetry was a perfectly natural flow of speech, and the best-liked pieces were those on subjects of nature written in free verse form. Perhaps the favorite was "Bloodroot," which appeared in the *Atlantic Monthly* for 1859 and was thought highly of by Oliver Wendell Holmes. The first eight lines may be quoted:

Beech trees, stretching their arms, rugged yet beautiful
Here shade meadow and brook; here the gay bobolink,
High poised over his mate, pours out his melody.
Here too, under the hill, blooms the wild violet;
Damp nooks hide, near the brook, bellworts that modestly,
Pale-faced, hanging their heads, droop there in silence, while
South winds, noiseless and soft, bring us the odor of
Birch twigs mingled with fresh buds of the hickory.

Another of Hill's excellent nature poems, "The

Buchanan, "Poetry and Mathematics," New York, 1929, "Poetry and Mathematics," pp. 3–24. G. Usai, "Matematica e poesia," Catania, 1932, 19 p.; inaugural address, Nov. 12, 1931, R. Istituto Superiore de Scienze Economiche e Commerciali di Catania.

[4] P. Lowell, "Chosön, the Land of the Morning Calm; a Sketch of Korea," Boston, 1886 [1885]; chapter 24, "My Friend the Mathematician," pp. 250–261.

[5] Cambridge, Mass., 1933, xvi + 226 pp. 23 plates. For further details of Birkhoff's life and work see R. C. Archibald, "A Semicentennial History of the American Mathematical Society, 1888–1938," New York, 1938, pp. 212–218.

[6] See *Scripta Mathematica*, 2: 78–79, 1933, and "Dict. Am. Biog.," v. 9, 1932.

[7] Cambridge, 1843; published by the author for the Massachusetts anti-slavery fair, Christmas, 1843.

[8] Boston, 1888, 237 pp. The first edition of this volume was a privately printed pamphlet (Portland, Me., 1887, 48 pp.), containing twenty poems.

Bobolink," was chosen by William Cullen Bryant for his "A Library of Poetry and Song."[9] Four of Hill's poems are in Griffith's collection, "The Poets of Maine,"[10] and his "Birthday Reflections" was published in London, as early as 1845, in a collection called "Flowers of Poetry."[11] These brief references to Hill's poetry must suffice.

During the first three quarters of the nineteenth century the most inspiring mathematician in the classroom of any American university was Benjamin Peirce (1809–1880), mathematician and astronomer, who taught at Harvard for half a century.[12] Not long ago President Emeritus Lowell recorded that he "still impresses me as having the most massive intellect with which I have ever come into close contact, and as being the most profoundly inspiring teacher that I ever had."[12] Peirce wrote a notable work on "Analytical Mechanics," and achieved remarkable pioneer results in linear associative algebra. At least three separate poems about him appeared in print.[13] Their general style can only be fully appreciated by those familiar with the life of Peirce and his modes of thought. The first, fourth and fifth stanzas of a ten-stanza poem published in the *Atlantic Monthly*,[14] by Oliver Wendell Holmes, Peirce's classmate at Harvard, were as follows:

For him the Architect of all
Unroofed our planet's starlit hall;
Through voids unknown to worlds unseen
His clearer vision rose serene.

How vast the workroom where he brought
The viewless implements of thought!
The wit how subtle, how profound,
That Nature's tangled web unwound;

That through the clouded matrix saw
The crystal planes of shaping law,
Through these the sovereign skill that planned,—
The Father's care, the Master's Hand!

In very recent days there has been another creative poet, a member of the present mathematical group in the National Academy of Sciences, who was a lecturer at Harvard in 1925–26. I refer to Eric Temple Bell[15] (1883–), a native of Aberdeen, Scotland, who came to America in his youth and was later greatly to enrich its cultural life. He has been a professor of mathematics at the California Institute of Technology for the past twelve years. Among his nineteen books are nine novels (written under the *nom de plume* of John Taine), and the remarkable "Men of Mathematics." But his first two books were volumes of verse "By J. T."[16] There is much to interest the mathematician in the manner of Bell's treatment of a wide range of themes, and of a variety of verse forms. The first volume contains sonnets on "Newton," "James Clerk Maxwell" and "William Thomson—Lord Kelvin," and a poem on "Johann Sebastian Bach." There are over seventy poems in the first volume and about a dozen in the second. In the latter, the first poem, "The Singer," fills over 120 pages. Bell's novel "Green Fire"[17] was dramatized into a three-act play by Glenn Hughes, and the Pasadena Community Playhouse Association gave several performances of it in 1931.

Turning next to another important scientific center in the state, the University of California at Berkeley, we find that only a few months ago death claimed one of her rarely gifted members of the mathematics department, who, for many years, had there achieved notably in the fields of mathematics, poetry and music. I refer to the beloved Derrick Norman Lehmer[18] (1867–1938), author of mathematical papers and of great mathematical tables, published by the Carnegie Institution and used by scholars throughout the world. For a decade before its recent demise he was the editor of the literary magazine, called the *University of California Chronicle*. He published scores of poems, some of them very extensive, in such periodicals as *Overland Monthly, Poetry, Silhouettes, Step Ladder, Lyric West, University of California Chronicle, Poetry Review* (London), *Poetry of To-day* (London) and *Atlantic Monthly;* and in "West Winds. An Anthology of Verse,"[19] in various volumes of "California Writers Club Poems"[20] and in other poetical anthologies.[21]

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[9] New York, 1871, p. 345.

[10] G. B. Griffith, Portland, Me., 1888, pp. 211–214.

[11] Pp. 271–273. There is also Hill's "Prosing in Rhyme," in "The Centenary of Leicester Academy" . . ., Worcester, Mass., 1884, pp. 63–67.

[12] "Benjamin Peirce, 1809–1880, Biographical Sketch and Bibliography," by R. C. Archibald, and "Reminiscences," by C. W. Eliot, A. L. Lowell, W. E. Byerly and A. B. Chace, Oberlin, O., 1925. Reprinted with new material and portraits from *Am. Math. Mo.*, v. 32, 1925. See also "Dict. Am. Biog.," v. 14, 1934, pp. 393–397.

[13] By T. W. Parsons, T. Thwing and O. W. Holmes; see M. King, "Benjamin Peirce . . . A Memorial Collection," Cambridge, 1881.

[14] Vol. 46, 1880, pp. 823–824.

[15] See "Who's Who in America," v. 20, 1938; "American Men of Science," sixth ed., 1938; *Scripta Mathematica*, 2: 375–376, 1934.

[16] "Recreations," Boston, The Gorham Press, 1915, 151 pp.; "The Singer," *idem.*, 1916, 166 pp.

[17] "Green Fire, the Story of the Terrible Days in the Summer of 1890. Now told in full for the first Time," New York, Dutton, 1928.

[18] See "Who's Who in America," v. 20, New York, 1938; "American Men of Science," sixth ed., New York, 1938.

[19] By members of the California Writers Club, San Francisco, 1925, pp. 98–99, 103–104.

[20] San Francisco, 1930, pp. 21–24, group of children's poems ("That Strange Land," "Dandelion Faeries," "Rumpelstiltskin," "Old Daddy Red-Cap," "Giant Blunderbore"); 1932, "Spring Gossip"; 1933, "The New Thanatopsis" and "I?"

[21] A. H. Bartlett, comp., "Sea Anthology," London, 1924, "The Limpet"; E. Markham, comp., "The Book of Poetry," New York, 1926, "Riches"; E. Markham, comp., "Songs and Stories" (California Series), Los Angeles,

Lehmer was a virile master in the writing of ballads, where the tale is always forcefully told and the interest finely sustained. He collected ten of his best ballads in the recent volume, "Fightery Dick and Other Poems."[22] For twenty years he traveled among Indians of the West, and made hundreds of valuable phonograph records of their songs. To melodies and words, or vocables, thus obtained he has added suitable simple harmonics with flute obbligato and, in some cases, wrote English poetry in keeping with the music. He published a number of collections of such songs.[23] Furthermore, two Indian operas, "The Harvest" and "The Necklace of the Sun," for which he wrote both libretti and music, were performed with success in Oakland, San José and San Francisco, California, in 1933 and 1935.

In referring to Indians our thought naturally turns to Dartmouth College, which originated in Connecticut, as a charity school for Indians. At this college during 1911–1932 the head of the department of mathematics was a man of culture and of outstanding abilities as teacher, organizer, committee man and editor, John Wesley Young[24] (1879–1932). He also achieved noteworthy mathematical research publication. On his death the following poem,[25] which struck a responsive chord in the heart of every friend, was written by Alexander K. Laing, the prominent American poet and author:

VALE: CY YOUNG

A week ago: your hand, in my hand resting—
The shy, queer smile that never went away.
A week ago: your jest, to crown my jesting—
Sunlight at nightfall on a gloomy day.

Long I shall cherish that last careless meeting,
That picture, stamped unfading on the brain:
Symbol of you, who offered life a greeting
Of banter, for its surly gift of pain.

Great heart, grown quiet, merely to have seen you
Wear, as an honored garment, such great ruth,
Made us your debtors. Death cannot demean you
Who taught us manhood in our stumbling youth.

Arthur Sherburne Hardy[26] (1847–1930) was another professor of mathematics at Dartmouth College, namely, for the fifteen years 1878–93, and during that time he wrote not only volumes of mathematical texts such as: "Elements of Quaternions" (1881), "New Methods in Topographical Surveying" (1884), "Elements of Analytic Geometry" (1889) and "Elements of the Calculus" (1890), but also three novels, "But Yet a Woman" (1883), "Wind of Destiny" (1886), "Passe Rose" (1889) and a small volume, "Francesca of Rimini. A Poem."[27] This last volume was his first book, and it is written in Chaucerian rhyme royal. On leaving Dartmouth, Professor Hardy was for two years editor of the *Cosmopolitan Magazine*. Shortly thereafter followed eight years (1897–1905) as the United States minister to Persia, Greece, Roumania, Servia, Switzerland and Spain. Then, and later, six other novels and another volume of poetry flowed from his pen. This second volume of poetry, a product of the Merrymount Press, was given the title of its first part, "Songs of Two,"[28] and its second part, called "Verses," includes the poem "Duality," which had first appeared several years before.[29] Yet other poems of Hardy, written to a little child, are to be found in his "A May and November Correspondence,"[30] published shortly before he died.

Since Hardy was our ambassador to Persia and also to Spain, we may next appropriately visit these countries. Few there are who do not know of the Rubaiyat of the eleventh-century Persian poet, popularly known as Omar Khayyám,[31] and of Edward

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1930, "The Stroller," "Riches"; H. Harrison, comp., "California Poets," New York (?), 1932, "The Feud," "Eviction"; "World's Fair Anthology," Exposition Press, New York, 1939, "Edgar Allan Poe"; "Golden Gate Anthology," Tudor House, New York, 1939, "Prophecy."

[22] New York, 1936, x + 138 pp.

[23] (a) "Seven Indian Songs from the Yosemite Valley," published under the auspices of The National Society of Colonial Dames resident in California, Berkeley, 1924, 19 + 4 pp., 4to, 8 songs with flute obbligato; (b) "Down the Stream and Other Indian Songs," Berkeley, 1927, 11 + 1 pp., 5 songs with flute obbligato; (c) "Two Indian Choruses" "Buffalo Song" and "Invocation to the Sun," Berkeley, 1927, 7 pp.; (d) "Indian Camp-Fire Songs. Easy *four-part arrangements* of Indian Songs for Junior and Senior High Schools," Berkeley, 1930, 15 pp., 8 songs; (e) "Indian Songs from the Northland," Berkeley, 1931, 13 pp., 5 songs; (f) "Fingers of the Sun and other Indian Songs from the Sierra Slopes," Berkeley, 1931, 13 pp., 6 songs; (g) "Indian Songs from the Mesas," Berkeley, 1932, 13 pp., 5 songs. He published also "Five Songs from the Tundras, an Eskimo Song Cycle," Berkeley, 1932, 9 pp.

[24] See *Am. Math. Mo.*, 39: pp. 309–314, 1932; "American Men of Science," fourth ed., 1927; R. C. Archibald, "A Semicentennial History of the American Mathematical Society," 1938.

[25] *The Dartmouth*, 93: 2, February 20, 1932.

[26] "Dict. Am. Biog.," vol. 8, 1932. A. S. Hardy, "Things Remembered," Boston and New York, 1923.

[27] Philadelphia, 1878, 46 pp.

[28] New York, 1900, 36 pp.

[29] "The First Book of the Authors Club; Liber Scriptorum," New York, 1893, p. 272.

[30] Boston, Mass., 1928, 24 pp. and portrait and facsimile plates.

[31] W. E. Story, "Omar Khayyám as a Mathematician" [Needham, Mass.], 1919, 17 pp. and portrait of Story (also in "Twenty Years of the Omar Khayyám Club of America," 1921, privately printed by the Rosemary Press; "Omar as a Mathematician," pp. 70–81; Poems, "Omar Khayyám," by N. H. Dole, pp. 28–30, by G. Roe, pp. 34–36). A. G. Potter, "A Bibliography of Printed Editions of the Quatrains of Omar Khayyám in Foreign Languages," privately printed for members of the Omar Khayyám Club of America, 1923. There is also a bibliography in E. Heron-Allen's edition and translation of the Rubaiyat, Boston, 1898, pp. 279–286. D. S. Kasir, "The Algebra of Omar Khayyám," New York, Columbia University, 1931, especially pp. 1–39. J. Hay, "In Praise of Omar," T. B. Mosher, Portland, Me., 1898; address be-

Fitzgerald's beautiful, though not wholly literal, translation of the Rubaiyat[32] into English in 1859. To this are largely due its popularity, the establishment of numerous Omar Khayyám clubs and a long series of special publications. It is not so generally known that Omar Khayyám was the originator of a notable calendar, and wrote an important work on algebra, as well as a commentary on difficulties in Euclid's "Elements," very much like early discussions of non-Euclidean geometry.[33]

Fitzgerald's work in connection with 101 quatrains was sufficient to impel various other people to rush into print with translations of other quatrains of more or less doubtful authenticity; thus Whinfield gave 500 quatrains.[34] Another, innocent of knowledge of Persian, conceived the idea of eliminating the more doubtful of this number and having a Persian scholar make a literal translation into English of 289 quatrains, so as to give, as he conceived it, a truer picture of the original text. Having this literal translation before him he put it into metrical form and had it published in a most beautiful volume adorned with twelve remarkable illustrations in colors by an eminent Persian artist.[35] The author of this metrical translation, David Eugene Smith[36] (1860–), is one of the best loved among American mathematicians, and great is the debt which the United States owes to him for inspiring so many of the teaching fraternity. The popularity of his text-books and historical writings may be inferred from the fact that during each of the three years 1927–29, more than a million copies of his books were sold by his publisher. These included Spanish editions of several of his works used in Cuba and South America.

Omar's quatrains have been translated into many languages, and in some of these languages many translations have been made, in part antedating the translation of Fitzgerald. Danish, French, German and Italian translations are well known; but there have also been Basque, Catalanese, Czech, Dutch, Esperanto, Gaelic, Hebrew, Hungarian, Japanese, Latin, Welsh, Welsh Romany and Yiddish. There are many musical settings for the quatrains, of which the beautiful ones of Liza Lehmann, finely recorded on gramophone records, are the most notable.

Many poems about Omar have been brought together in a little volume edited by E. M. Moore.[37] Among the authors of these are the following: T. B. Aldrich, Austin Dobson, Edmund Gosse, Andrew Lang, R. Le Gallienne, J. R. Lowell, J. H. McCarthy and Stephen Phillips.

And now to Spain! The mathematician of all time to attain the greatest financial reward for his poetic and dramatic efforts was the very gifted and versatile Spaniard, José Echegaray,[38] who was born in 1832 and died in 1916. He ruled the Spanish stage unchallenged for the twenty years 1874–1894, and was a Nobel prize winner in literature in 1904, when 72 years of age, "in appreciation," to use the words of the award, "of his comprehensive and intellectual authorship which, in an independent and original way, has brought to life again the great traditions of Spanish drama."[39] Of the 65 dramatic pieces which he wrote many were translated into foreign languages such as Dutch, English, French, German, Greek, Italian, Portuguese and Russian. English translations[39] of "The Madman Divine," "Madman or Saint" and "Always Ridiculous" were published in Boston, in *Poet Lore.* But these are said to be trivial in literary value beside two of later years, "The Great Galeoto" and "The Son of Don Juan."

Echegaray's writing of plays began about 1868, when he was appointed professor of mathematical physics at the University of Madrid, and became a member of the Cortes. For five years he was minister of public works and finance. He is the author of

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fore the Omar Khayyám Club, London, Dec., 1897. G. Sarton, "Introduction to the History of Science," vol. 1, Washington, 1927, pp. 759–761; H. Lamb, "Omar Khayyám, A Life," Garden City, N. Y., 1934, viii + 316 pp. Romances: (a) N. H. Dole, "Omar, the Tentmaker; a Romance of Old Persia," Boston, 1899, viii + 365 pp.; (b) H. Macfall, "The Three Students," London, 1926, viii + 351 pp., attractively written. G. Sarton, "The Tomb of Omar Khayyâm," *Isis*, 29: 15–19, 1938, with plate illustration of the magnificent tomb at Nishâpûr. See also J. Fleming, "A Pilgrim to Omar's Forgotten Tomb," *Travel*, 58: 9–14, April, 1932.

[32] The four Fitzgerald editions of the Rubaiyat (1859–79) were brought together in a single volume of the Golden Treasury Series, London, 1899. See also the beautiful edition of Thomas B. Mosher, Portland, Me., 1902.

[33] D. E. Smith, "Euclid, Omar Khayyâm, and Saccheri," *Scripta Mathematica*, 3: 5–10, 1935.

[34] E. H. Whinfield, London, 1883.

[35] New York, 1933.

[36] *Scripta Mathematica*, 4: 182–184, 1936, and *Osiris*, 1: 9–34, 1936, with portrait. While traveling in Persia shortly after his Omar was published, Professor Smith was presented to the Shah, decorated with the Gold Star of the Order of Elim, of the first rank, and presented with an autographed portrait of the Shah.

[37] "To Omar. Spoil of the North Wind," Blue Sky Press, Chicago, 1900, 93 pp.

[38] J. Cejador y Frauca, "Historia de la Lengua y Literatura Castellana," Madrid, v. 9, pp. 111–128, 1918, with portrait; G. B. Shaw, "Dramatic Opinions and Essays," New York, 1907, v. 1, pp. 81–89; v. 2, pp. 186–194; N. A. Smith, "José Echegaray," *Poet Lore*, 20: 218–228, 1909; S. G. Morley, "José Echegaray," *Univ. California Chronicle*, 27: 368–379, 1925; F. W. Chandler, "Modern Continental Playwrights," New York, 1931, "Peninsular Tradition: Echegaray, Pérez Galdós Guimerá," pp. 465–486; *Scripta Mathematica*, 1: 265–266, 1933.

[39] A. R. Marble, "The Nobel Prize Winners in Literature," New York, 1925, pp. 239–246, 282–283 (bibliography). For further bibliography of Echegaray see A. Flores, "Spanish Literature in English Translation, a Bibliographical Syllabus," New York, 1926, pp. 46–48; various editions of ten plays in English translation are listed.

many mathematical and scientific works on such subjects as calculus of variations (1858), theory of determinants (1868), elementary theory of thermodynamics (1868), mathematical theory of light (1871), modern theories of physics (5 v., 1883–89), and popular science (2 v., 1905). At the time of his death in 1916 he was the president of the Spanish Mathematical Society.[40]

In listing Omar's mathematical work I referred to his commentary on one of the works of Euclid. The magnificently endowed University of Alexandria opened about 300 B.C., and Euclid was there a professor of mathematics. Not less than ten mathematical treatises are to be attributed to him as author, and of these approximately complete texts of five are available. But by far the most famous one was his monumental work on geometry, containing 465 propositions, called "The Elements." More than a thousand editions have appeared since the first one[41] printed in 1482, and for 1,800 years before that, manuscript copies dominated all teaching of geometry. The following old English verses, which Halliwell has printed in one of his books,[42] show, if his ms. source is reliable, that Euclid's work was used in England as far back as King Adelstone, early in the tenth century.

> The clerk Euclide on this wyse hit fonde
> Thys craft of geometry, yn Egypte londe
> Yn Egypte he tawghte hyt ful wyde,
> In dyvers londe on every syde.
> Mony yerys afterwarde y understonde
> Yer that the craft com ynto thys londe.
> Thys craft com into England, as y yow say,
> Yn tyme of good Kyng Adelstone's Day.

There are many incidental references to Euclid in poetry. For example, in the fifth book of Wordsworth's "Prelude" the following lines may be recalled in the dream, which, according to De Quincey, "reaches the very *ne plus ultra* of sublimity":

> I looked and looked, self-questioned what this freight
> Which the new-comer carried through the waste
> Could mean, the Arab told me that the stone
> (To give it in the language of the dream)
> Was ''Euclid's Elements.''

During the past fifteen years two poems on Euclid have been published in this country—the one by Vachel Lindsay[43] and the other by Edna St. Vincent Millay.[44] The latter's sonnet is as follows[44a]:

> Euclid alone has looked on Beauty bare.
> Let all who prate of Beauty hold their peace,
> And lay them prone upon the earth and cease
> To ponder on themselves, the while they stare
> At nothing, intrically drawn nowhere
> In shapes of shifting lineage; let geese
> Gabble and hiss, but heroes seek release
> From dusty bondage into luminous air.
> O blinding hour, O holy, terrible day,
> When first the shaft into his vision shone
> Of light anatomized! Euclid alone
> Has looked on Beauty bare. Fortunate they
> Who, though once only and then but far away,
> Have heard her massive sandal set on stone.

And now for another Greek of slightly later day. Should mathematicians be asked, who were the five greatest mathematicians who ever lived, their responses would probably agree, and the list begin with the names of Archimedes[45] and Newton. Archimedes, who flourished about 225 B.C., made most extraordinary discoveries, some of which called for use of what is equivalent to the solution of problems by the integral calculus, first later developed in more detail by Newton. Two of these results are that the volume of a sphere is exactly equal to two thirds that of its circumscribed cylinder, and that the area of the sphere was exactly equal to that of the cylinder. Archimedes was so proud of proving these results, he requested that the figure of a sphere in a cylinder be engraved on his tomb; Cicero found it there, as he tells us in his "Tusculan Disputations."

In this mechanistic age one may well recall Wordsworth's lines on Archimedes in book 8 of "The Excursion":[46]

> Call Archimedes from his buried tomb
> Upon the plain of vanished Syracuse,
> And feelingly the sage shall make report
> How insecure, how baseless in itself
> Is the philosophy, whose sway depends
> On mere material instruments; how weak
> Those arts, and high inventions, if unpropped
> By virtue.—

Somewhat the same underlying thought is suggested by Schiller's poem, "Archimedes und der Schüler,"[47] which may be roughly translated as follows:[48]

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[40] J. A. Sánchez Pérez, *Revista Matemática Hispano-Americana*, ser. 2, 7: 49–58, 1932, with portrait frontispiece of Echegaray; see also *Revista de la Sociedad Matemática Española*, 5: 281–282, 1916, and 6: 1–6 (by P. Carrasco), 1917.

[41] P. Riccardi, ''Saggio di una Bibliografia Euclidea,'' Bologna, 1887–93; C. Thomas-Stanford, ''Early Editions of Euclid's Elements,'' London, Bibliographical Society, 1926.

[42] J. O. Halliwell, ''Rara Mathematica,'' second ed., London, 1841, p. 56, reproduced from Ms. Bib. Reg. Mus. Brit. 17A.1.f2^b – 3, which dates from the fifteenth century.

[43] V. Lindsay, (a) ''Collected Poems,'' rev. and illustr. ed., New York, 1926, p. 231 in ''Moon-Poems''; (b) ''Golden Book,'' v. 13, 1931, p. 31.

[44] E. Millay, ''The Harp-Weaver and Other Poems,'' New York, 1923, p. 74. See also ''The Home Book of Modern Verse,'' ed. by B. E. Stevenson, New York, 1925, p. 622; and ''The Riverside Book of Verse 1250–1925,'' ed. by R. M. Gay, Boston and New York, 1927, p. 610.

[44a] I am indebted to Miss Millay (Mrs. Boissevain) for kind permission to reprint this sonnet.

[45] T. L. Heath, (a) ''Archimedes'' (Pioneers of Progress) London, 1920; (b) ''Manual of Greek Mathematics,'' Oxford, 1931. *Scripta Mathematica*, 2: 75–76, 363, 1933; 4: 82, 273–274, 1936.

[46] ''The Complete Poetical Works of William Wordsworth,'' Cambridge ed., Boston, 1904, bk. 8, ll. 220–227.

To Archimedes once came a youth intent upon knowledge.
Said he ''Initiate me into the science divine,
Which to our country has borne glorious fruits in abundance,
And which the walls of the town 'gainst the Sambuca protects'';
''Callst thou the science divine? It is so,'' the wise man responded;
''But so it was, my son, ere the state by her service was blest.
Would'st thou have fruit of her only? Mortals with that can provide thee,
He who the *goddess* would woo, seek not the woman in her.''

There are many other allusions to Archimedes and his work in poetry of different languages, but I shall not touch upon these except to draw attention to Stephen Vincent Benet's 120-line poem, "Archimedes' last foray,"[49] published about thirteen years ago with the motto, "And . . . having sought for a lever wherewith to move the world . . . he was slain . . . ."

The reference to Wordsworth leads next to consideration of one of his intimate friends. In Great Britain in the first half of the nineteenth century there were two great scholars of similar names. The older was Sir William Hamilton, baronet, one of the most eminent of Scottish metaphysicians, and the other Sir William Rowan Hamilton, knight (1805–1865), outstanding Irish mathematician.[50] The latter was a child prodigy, like John Stuart Mill. At three years of age he was a superior reader of English and considerably advanced in arithmetic; at four a good geographer; at five able to read and translate Latin, Greek and Hebrew, and liked to recite Dryden, Collins, Milton and Homer; at eight a reader of Italian and French and giving vent to his feelings in extemporized Latin; at ten a student of Arabic and Sanscrit. When twelve years old he met Zerah Colburn, the American calculating boy,[50a] and engaged with him in trials of arithmetical skill in which Hamilton came off with honor. His career at Trinity College, Dublin, was extraordinary in that he achieved the previously unheard-of distinction of winning the highest possible marks both in mathematical physics and in Greek. Before entering college he was accustomed to translate Homer into blank verse, comparing his result with translations of Pope and Cowper, and he had already produced a number of original poems. These poems and about 100 others have been preserved in Hamilton's monumental biography.[51] While still an undergraduate Hamilton was appointed professor of astronomy. Before assuming the duties of his chair he made a tour through England and Scotland and thus met the poet Wordsworth for the first time, in 1827. The two men took to each other at once, and they remained close friends up to the day of the poet's death 23 years later. Wordsworth greatly loved and admired the young mathematician, declaring that Coleridge and Hamilton were the two most wonderful men, taking all their endowments together, that he had ever met. Here is Hamilton's account of their first meeting:

"Wordsworth with whom I spent the evening—I might almost say the night—of yesterday, for he and I were taking a midnight walk together for a long, long time, without any companion except the stars and our own burning thoughts and words." He goes on to record how Wordsworth walked back with him to his lodging about a mile distant. Hamilton then offered to return with Wordsworth, and their conversation was so interesting that, arrived at his house, Wordsworth turned back once more, when Hamilton again accompanied him home. From then on he sent Wordsworth the verses which he wrote in great quantity and with great facility. In 1831 Wordsworth wrote[52]: "You send me showers of verses which I receive with much pleasure, as do we all: yet have we fears that this employment may seduce you from the path of science which you seem destined to tread with so much honor to yourself and profit to others. Again and again I must repeat that the composition of verse is infinitely more of an art than men are prepared to believe, and absolute success in it depends upon innumerable *minutiae* which it grieves me you should stoop to acquire a knowledge of. . . . Again I do submit to your consideration, whether the poetical parts of your nature would not find a field more favorable to their exercise in the regions of prose; not because those regions are humbler, but because they may be gracefully and profitably trod, with footsteps less careful and in measures less elaborate." While Hamilton continued to indulge in poetical effusions with no little copiousness, Wordsworth's counsels were sufficient to decide him to dedicate his life to scientific research. In this direction three achievements may be mentioned: his notable discoveries in geometrical optics; "Hamiltonian equations," which are fundamental in discussions of dynamical problems; and his great works on quaternions, a subject of which he was the creator.

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[47] For example, Schiller, ''Sämmtliche Schriften,'' hist.-krit, Ausg. v. K. Goedeke, 11: 92, 1871. Compare ''Archimedes und der Jüngling,'' a parody by C. G. J. Jacobi, Crelle's *Jour. f. Math.*, 101: 338, 1887, or Kronecker, ''Werke,'' Leipzig, v. 3, 1899, p. 252.

[48] R. E. Moritz, ''Memorabilia Mathematica,'' New York, 1914, p. 138.

[49] See, for example, W. S. Braithwaite, ed., ''Anthology of Magazine Verse for 1926,'' Boston, 1926, pp. 36–40; *Saturday Rev. Lit.*, 2: 871, June 19, 1926.

[50] A. Macfarlane, ''Lectures on Ten British Mathematicians of the Nineteenth Century,'' New York, 1916, pp. 34–49. E. T. Bell, ''Men of Mathematics,'' New York, 1937, pp. 340–361.

[50a] ''A Memoir of Zerah Colburn written by Himself,'' Springfield, Mass., 1833; F. D. Mitchell, ''Mathematical Prodigies,'' *Amer. Jour. Psychology*, 18, 1907.

[51] R. P. Graves, ''Life of Sir William Rowan Hamilton, knt.,'' 3 v., Dublin, 1882–89.

[52] Graves, ''Life,'' v. 1, pp. 491–492.

I wonder if it may not have been mainly due to association with Hamilton that Wordsworth's poems contain at least a dozen references, more, I believe, than made by any other poet, to mathematics and mathematicians. Most of these references are in "The Prelude," but there are others in "The Excursion" and in "Epitaphs translated from Chiabrera."

(*To be concluded*)

OBITUARY

CHARLES EDWARD MUNROE

THE death of Professor Charles Edward Munroe in his ninetieth year at his home in Forest Glen, Maryland, on the afternoon of December 7, 1938, marked the passing of a distinguished and most beloved American man of science. He was born in Cambridge, Massachusetts, on May 24, 1849, and his long career as student, teacher, consulting expert and investigator of chemistry spanned the entire period of modern industrial development.

Munroe's love of chemistry began early, and from first to last it was joyful, compelling and infectious. As a young boy he equipped a small chemical laboratory in an attic room, over the entrance of which, in the merry spirit that always stayed with him, he inscribed the words, "All hope abandon ye who enter here." Desirous of increasing his stock of chemicals, he went one day to the neighboring drug store of Dr. Abner Ham to buy an ounce of potassium cyanide. The venerable doctor peered down at the lad through his glasses and asked with surprise what he wished to do with so poisonous a substance. "To make experiments," replied the boy. Dr. Ham then questioned him and, finding that he had picked up an amount of chemical knowledge unusual for one so young, decided that what he needed most was not potassium cyanide but direction. He offered him therefore a position as helper and errand boy, together with the opportunity of making such chemical experiments as discretion and the resources of his store permitted. The proposal was eagerly accepted.

The zeal for chemistry, thus early aroused, accompanied Munroe into the Cambridge High School and then through the Lawrence Scientific School of Harvard, from which he graduated in the class of 1871 with the mark of *summa cum laude*. For the next three years he taught chemistry at Harvard in the courses of Professors O. Wolcott Gibbs and Josiah P. Cooke, of both of whom Munroe always spoke with admiring affection. Although there was a certain professional coolness between Gibbs and Cooke, Munroe was successful in maintaining cordial relations with both. In fact a cardinal trait of his character was a conciliatory spirit which made it impossible for him to become a partisan in the quarrels of his friends.

Among Munroe's chemistry pupils at Harvard was Harvey W. Wiley, of the class of '73, and between those two arose a deep and lasting friendship. Wiley, who was Munroe's senior by five years, was then pursuing a year of postgraduate study and being a B.A. of Hanover College had no intention of taking another degree. Munroe, however, persuaded him to try for a B.S. at Harvard, but the regulations required that he must first pass the examinations for each of the four college years. Wiley, after being duly coached by Munroe, had no difficulty in fulfilling this requirement, and he thereby attained the unique distinction of being promoted from freshman to senior year in the brief space of seventeen days. Helping Wiley to run this gauntlet of tests was jokingly referred to by Munroe as his greatest pedagogical achievement.

Munroe left Harvard in 1874 to accept the professorship of chemistry at the United States Naval Academy, where he remained until 1886. He then transferred his residence to Newport, where he served as chemist of the United States Naval Torpedo Station and War College until 1892. It was during this period that he conducted his famous researches on explosives. His fearless experiments in this field led to the invention of the smokeless powder called "Indurite" (U.S. Patent 489684) and to the discovery of the remarkable Munroe effect by which the outlines of a fragile leaf or photograph can be impressed upon a plate of the hardest steel by means of a powerful explosive. In 1892 he moved to Washington, where he served as professor of chemistry and dean of the Graduate School of George Washington University until his retirement as professor emeritus in 1918. He continued, however, to serve as consulting expert and chief explosives chemist of the U. S. Bureau of Mines until 1934, when failing health obliged him to resign the position.

Coincident with these main activities, Munroe discharged various miscellaneous public services which are too numerous to mention in detail. He was a member of the U. S. Assay Commission for 1885, 1890 and 1893 and consulting expert of the engineering board for the defense of Washington during the Spanish American War. His copious reports for the censuses of 1900, 1905 and 1910, as expert agent in charge of chemical industries, are invaluable for their wealth of historical and statistical information. He served also at various times as consulting expert for the U. S. Geological Survey, the U. S. Forestry Service and the Civil Service Commission, and was chairman of the advisory committee of the American Railway Association for drafting regulations on the safe transportation of explosives. He was chairman of the Committee on Explosives of the American Society of Testing Materials and also of the Committee on Explosives Investigations of the National Research Council. His name is writ large in the history of the American explosives industry.

No less extensive were Munroe's services for the numerous scientific societies of which he was a member. In 1873 at the meeting of the American Association for the Advancement of Science in Portland, Maine, he was secretary of a group of distinguished chemists (among whom were seven future presidents of the American Chemical Society) who petitioned the association for the formation of a subsection of chemistry. This was a recognized feature of the association until 1881, when it was made a full section. Munroe was the last survivor of this original group of founders of Section C. He was also the last surviving charter member of the American Chemical Society (founded in 1876), which honored him with its presidency in 1898. His services to this body, of which he was a life member, were of the highest order. In the early days when the American Chemical Society, because of mismanagement, was threatened with disruption, no less than seven of its future presidents having resigned, it was Munroe who, adhering loyally to his membership, organized the first local section and the first general meeting of the society at Newport, which, with the other reforms that he helped to initiate, restored harmony to the shattered organization and set it for the first time on the path that led to its subsequent phenomenal growth. When collaborators were lacking to write the chapter on "Industrial Chemistry" for the fiftieth anniversary number of the *Journal of the American Chemical Society* in 1926 it was Munroe again who saved the day by voluntarily assuming this extra burden. He served continuously as associate editor on explosives for *Chemical Abstracts* from the first issue of this journal in 1907 until death terminated the activity of his pen.

In addition to the various domestic and foreign chemical societies to which he belonged, Munroe was a member of the American Association for the Advancement of Science, the American Philosophical Society and the American Academy of Arts and Sciences. He was a recipient of numerous honors, among which were a membership in the Turkish Order of Medjidieh and a decoration of the Order of Leopold from Belgium.

In his social relations, Munroe was a prince among men. Within his large circle of friends at the Cosmos Club (of which he was president in 1913–1914) cordiality and good will radiated from him as light from the sun. Like his old college chums, F. W. Clarke and H. W. Wiley, he had a jovial temperament, and those who were so fortunate as to join this famous trio of Harvard men in one of their festive gatherings will always remember the spontaneous flow of wit and merriment.

On June 20, 1883, Professor Munroe married Mary Louise Barker, daughter of the late Professor George F. Barker, also a charter member and past president of the American Chemical Society, and just fifty years later he and Mrs. Munroe, surrounded by their five children and numerous grandchildren, celebrated their golden wedding anniversary. Munroe's life was singularly happy and productive. He was the last brilliant example of the old school chemist who cultivated his science upon all its sides, who saw it steadily and saw it whole. To him may be applied those words of Ariosto, "Nature made him and then broke the mould."

C. A. BROWNE

RECENT DEATHS AND MEMORIALS

DR. HENRY VANPETERS WILSON, Kenan professor of zoology at the University of North Carolina and since 1891 head of the department until his retirement two years ago, died on January 4 in his seventy-sixth year.

DR. FABIAN FRANKLIN, professor of mathematics in the Johns Hopkins University from 1879 to 1895, later editor of the *Baltimore News* and associate editor of the *New York Evening Post*, died on January 8 at the age of eighty-six years.

DR. LOUIS ISRAEL HARRIS, health commissioner of New York City from 1926 until 1928, died on January 6 at the age of fifty-six years.

DR. WARREN KING MOOREHEAD, professor emeritus of Phillips Academy at Andover, Mass., and curator of its museum, died on January 5 at the age of seventy-two years.

PROFESSOR H. J. BAKER, director of the extension service for the New Jersey Agricultural Experiment Station at Rutgers University, died on January 6 at the age of fifty-three years.

DR. GEORGE BARGER, Regius professor of chemistry at the University of Glasgow, known for his work on alkaloids and the synthesis of thyroxin, died on January 6. He was sixty years old. Dr. Barger lectured at Cornell University and at the Johns Hopkins University in 1928.

SCIENTIFIC EVENTS

THE OCEANOGRAPHIC VESSEL CULVER OF THE BERMUDA BIOLOGICAL STATION

THE oceanographic vessel *Culver* has arrived at the Bermuda Islands from England for a five-year survey in cooperation with the Bermuda Biological Station and the Woods Hole Oceanographic Institution to measure the oscillation of the Gulf Stream. It is hoped that the survey may help to avert the next great drought in the United States Mid-West, predicting it in time to avert disastrous results to United States farming, and that it may also prove an aid to commercial fishermen in determining movements of fisheries in European waters.

The *Culver* is especially equipped for the Biological Station. It was purchased and refitted with a grant from the Development Commission of Great Britain. Through the Royal Society of London an additional grant may be made for the next five years for the operation of the vessel.

Professor Walter Garstang and Dr. Robert Gurney, of the University of Oxford, spent some time at the Bermuda Biological Station three years ago and returned to England impressed with the possibilities of the station for oceanographic work.

Professor Garstang is reported to have said:

> We went back to England with the thought that the English people ought to be told something about the features of the Bermuda colony which they seemed to have forgotten. We told them that Bermuda was a beautiful island perched on a pinnacle in the middle of the most interesting of all oceans, surrounded by deep waters which could be reached within an hour or less from the laboratory. We have been able to prove what we said. We caught a little creature—of no practical importance but very important scientifically—which had been caught only once before on a German ship which made an expedition into the Indian Ocean and southern Atlantic.

When Dr. Garstang and Dr. Gurney first returned they thought that if a small vessel could be obtained to be used more or less as a tender for the station, it would suffice. However, the Royal Society and the Development Commission favored a larger scheme, with the result that an ocean-going vessel was acquired.

The *Culver* is a converted yacht, 83 feet overall, with a beam of 19 feet, 3 inches. A spacious saloon will serve for a wardroom and a laboratory, and there are accommodations for three scientific men, the captain and the engineer, with crew quarters forward. The displacement of the vessel is 100 tons, and she is equipped with a new Diesel engine as an auxiliary to her sails. There is a large winch, operated from the vessel's main engines, for biological work. On the winch's cable is wound 3,500 fathoms of wire. For the hydrographic work there is an electrically driven winch forward—also with 3,500 fathoms of wire. The larger winch will be used for the nets; the smaller one will be used to let down water bottles in which samples of the ocean and temperatures, at various depths, will be taken.

The *Culver* will begin her work in the Gulf Stream. A double program, consisting of chemical and physical work and purely biological work, is planned. The former will be done in conjunction with the *Atlantis* within an area of sixty miles from Bermuda; the scientific men aboard the *Culver* will investigate local offshore currents. Quarterly cruises are planned for at least three or four years. The *Culver* will not be away from the station more than a week at a time, as it is necessary to get specimens into the laboratory quickly, and she will not go more than 100–150 miles from the islands. Entirely apart from the local aspects of the work are the hydrographic observations. Probably once a fortnight, but certainly once a month, the *Culver* will go to one or two defined stations, possibly 100 to 150 miles out, on this side of the Gulf Stream.

FARM RESEARCH LABORATORIES OF THE U. S. DEPARTMENT OF AGRICULTURE

DIRECTORS for the four farm research laboratories to be established by the Department of Agriculture to search for new and wider industrial outlets and markets for agricultural commodities have been announced by Dr. Henry G. Knight, chief of the Bureau of Chemistry and Soils. Dr. H. T. Herrick was recently appointed assistant chief of the bureau, having general supervision of the chemical and chemical engineering work in all four laboratories.

Each laboratory will have a broad circle of important contacts with industries, institutions and agricultural experiment stations. These will be largely in the hands of the individual directors. Included in the laboratory staff, which will be composed of several hundred people, there will be experts in many branches of science and technology, as well as fairly large business and service departments.

Dr. Knight pointed out that "The importance of the scientific studies undertaken in these laboratories demands that the director be a man with a record of successful research achievements plus the ability to inspire work of the highest professional character in others," and that "The men named have shown during their years of service with the department that they possess these desirable qualifications." They are as follows:

Northern Laboratory

The laboratory for the northern area, which includes the states of Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Ohio, Nebraska, North and South Dakota and Wisconsin, will be under the direction of Dr. O. E. May, until recently director of the Soybean Industrial Products Laboratory at Urbana, Illinois.

Southern Laboratory

The laboratory for the southern area, which includes the states of Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, Oklahoma, South Carolina and Texas, will be under the direction of D. F. J. Lynch, formerly chief of the Agricultural By-products Laboratory at Ames, Iowa.

Eastern Laboratory

The laboratory for the western area, which includes the states of Connecticut, Delaware, Kentucky, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, North Carolina, Pennsylvania, Rhode Island, Tennessee, Vermont, Virginia and West Virginia, will be under the direction of P. A. Wells, of the Industrial Farm Products Research Division of the Bureau of Chemistry and Soils.

Western Laboratory

The laboratory for the western area, which includes the states of Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington and Wyoming, will be under the direction of Dr. T. L. Swenson, of the Food Research Division of the Bureau of Chemistry and Soils.

ANNUAL REPORT OF THE DIRECTOR OF FIELD MUSEUM, CHICAGO

THE annual report of Dr. Clifford C. Gregg, director of Field Museum, Chicago, states that from the standpoint of service to the public, the year has been one of the most active and successful in the history of the institution.

The number of visitors received at the museum in 1938 has been approximately 1,390,000. This is an increase of about 100,000 over the 1937 attendance, which likewise had been more than 100,000 in excess of that registered in the preceding year. The balance of the more than 2,000,000 people brought directly within the sphere of the museum's influence consists of some 500,000 Chicago school children repeatedly reached by the 1,200 traveling natural history exhibits circulated by the N. W. Harris Public School Extension Department of the Museum, and approximately 180,000 children reached through lecturers sent into the schools by the James Nelson and Anna Louise Raymond Foundation of Field Museum.

Of the 1938 attendance, more than 93 per cent. were admitted free of charge, coming on the free days (Thursdays, Saturdays and Sundays), or belonging to classifications such as children, teachers and students who are admitted free on all days. Thus the 25-cent admission fee charged on other days was paid by less than 7 per cent. of the total number.

All departments of the museum made important additions to their exhibits in 1938. Among these are: in the department of anthropology, an entire new hall devoted to Asiatic ethnology; in the department of botany, a diorama reproducing a scene above the timberline in the Rocky Mountains of Wyoming, and in the paleontological division of the department of geology, several new and rare reassembled skeletons of prehistoric animals. Added to the department of zoology are a habitat group of Wedell's seals collected in the Antarctic by Admiral Byrd; groups of the quetzal, the national bird of Guatemala, and of the toucan and the oropendula or giant oriole of the same country, collected by an expedition sponsored by Leon Mandel, of Chicago; a group of storks and their nests, obtained through the cooperation of the Polish-American Chamber of Commerce in Warsaw; a lifelike mount of Su-Lin, famous giant panda of the Brookfield Zoo, which died in April; a habitat group of narwhals, collected off the Greenland coast by Captain Robert Bartlett, and a restoration of the extinct dodo.

In view of the fact that in 1938, as in other recent years, the depression has severely curtailed its budgets, it has been impossible for the museum to appropriate from its own funds for expeditions, the institution, however, was able to carry out an important expeditionary program with contributions from public-spirited Chicagoans. Sewell Avery sponsored four—a zoological expedition to British Guiana, a geological expedition in western and eastern parts of the United States and two botanical expeditions—one to Guatemala and one to Nova Scotia. Stanley Field, president of the museum, made available funds for continuation of the work, begun eight years ago, of archeological excavations of extensive scope and importance in southwestern Colorado. Dr. Wilfred H. Osgood, chief curator of zoology, personally financed and conducted an expedition concerned with biological research in New Mexico. Field work in other localities was conducted by other members of the staff. The museum press issued twenty-seven scientific publications and seven leaflets for lay readers.

THE NEW YORK MEETING OF THE AMERICAN ANTHROPOLOGICAL ASSOCIATION

AT the New York City meeting of the American Anthropological Association, the following officers were elected:

President, D. Jenness.
First Vice-president, J. M. Cooper (1939).
Second Vice-president, E. A. Hooton (1939–1940).
Third Vice-president, W. D. Strong (1939–1941).
Fourth Vice-president, R. F. Benedict (1939–1942).
Secretary, F. M. Setzler.
Treasurer, Bella Weitzner.
Editor, R. Linton.
Associate Editors, M. J. Herskovits, F. H. H. Roberts, Jr., Melville Jacobs.

Executive Committee, R. Redfield, E. C. Parsons, R. H. Lowie.

Representative to Social Science Research Council, R. H. Lowie (1939–1941).

Representative to American Council of Learned Societies, Franz Boas (1939–1942).

Representatives to National Research Council, J. A. Mason, Wendell C. Bennett, Fay-Cooper Cole (1939–1942).

Representatives to Section H, the American Association for the Advancement of Science, E. A. Hooton, C. Osgood (1939).

The following resolution was unanimously adopted at the 1938 annual meeting of the American Anthropological Association.

Whereas, The prime requisites of science are the honest and unbiased search for truth and the freedom to proclaim such truth when discovered and known; and,

Whereas, Anthropology in many countries is being conscripted and its data distorted and misinterpreted to serve the cause of an unscientific racialism rather than the cause of truth;

Be it resolved, That the American Anthropological Association repudiates such racialism and adheres to the following statement of facts:

(1) Race involves the inheritance of similar physical variations by large groups of mankind, but its psychological and cultural connotations, if they exist, have not been ascertained by science.

(2) The terms ''Aryan'' and ''Semitic'' have no racial significance whatsoever. They simply denote linguistic families.

(3) Anthropology provides no scientific basis for discrimination against any people on the ground of racial inferiority, religious affiliation or linguistic heritage.

DR. VANNEVAR BUSH, PRESIDENT OF THE CARNEGIE INSTITUTION OF WASHINGTON

DR. VANNEVAR BUSH, vice-president of the Massachusetts Institute of Technology and dean of the School of Engineering, entered upon his work as president of the Carnegie Institution of Washington on January 1. A year ago Dr. John C. Merriam, who has been president of the institution for eighteen years, requested the trustees to release him at the end of 1938 in order that he might resume his research work in paleontology and related fields. Last June Dr. Bush was elected to succeed Dr. Merriam.

Dr. Bush is a native of Everett, Mass., the son of the late Rev. R. Perry Bush, for fifty years a clergyman in the vicinity of Boston. He was graduated from Tufts College in 1913, and in 1916 was awarded the degree of doctor of engineering from Harvard University and the Massachusetts Institute of Technology. Early in his career he held a position in the test department of the General Electric Company, and then returned to Tufts College as an instructor in mathematics, later becoming assistant professor of electrical engineering. In 1932 he received from the college, of which he is a trustee, the honorary degree of doctor of science.

Dr. Bush was invited to join the faculty of the Massachusetts Institute of Technology in 1919 as professor of electric power transmission. He was appointed vice-president and dean of the School of Engineering of the institute in March, 1932. At the same time he was elected a member of the corporation of the institute.

Dr. Bush has been particularly interested in the design of advanced mathematical analyzing instruments and has had charge of a group of research workers which has produced several important instruments of this type. In recognition of work in this field, in 1928 he was awarded the Levy Medal of the Franklin Institute. Recognition has also been given him on account of the design which he developed of an intricate analyzing machine called the differential analyzer. This machine greatly increases the speed of scientific and engineering calculations. Another instrument in this group is the cinema integraph, which is just going into use. For his achievements in the development of methods and devices for the application of mathematical analysis to problems of electrical engineering, the American Institute of Electrical Engineers, in 1926, awarded to him the Lamme Medal. Dr. Bush has made also many important contributions to the improvement of vacuum tubes and has carried out distinguished research in the field of electric power transmission. He has also carried on important studies of transients in machines and dielectric phenomena.

As head of the Carnegie Institution of Washington Dr. Bush will be responsible for administering one of the largest non-governmental research budgets in existence, the current yearly expenditures approximating a million and a half dollars. In preparation for his work Dr. Bush has devoted much time during the past six months to acquainting himself with the organization of the institution and with its work and problems.

SCIENTIFIC NOTES AND NEWS

THE presentation of the Perkin Medal of the American Section of the Society of Chemical Industry to Dr. Walter S. Landis, vice-president of the American Cyanamid Company, was made on the evening of January 6 at the Chemists' Club, New York City. The medal address by Dr. Landis was entitled "Argon."

The Sylvanus Albert Reed Award for 1938, conferred annually by the Institute of the Aeronautical Sciences for a notable contribution to aeronautical engineering, has been awarded to Professor Alfred V. de Forest, professor of mechanical engineering at the Massachusetts Institute of Technology.

Dr. I. M. Heilbron, professor of organic chemistry at the Imperial College, London, has been awarded the Longstaff Medal of the Chemical Society, London, in recognition of his work in the field of natural products, especially vitamin A and related natural pigments, the anti-rachitic vitamin D and its precursors and the constituents of the fish liver oils and of natural resins of the triterpene group.

Professor Frank B. Morrison, professor of animal husbandry at Cornell University and head of the department, was recently the guest of honor at the annual dinner of the American Society of Animal Production, when his portrait was presented to the society. The painting will be hung in the gallery of men who have achieved fame in agriculture, particularly in animal industry. The award was made "in recognition of his achievements as teacher, research specialist and author."

Dr. W. J. de Haas, professor of physics in the University of Leiden, has been elected correspondent for the Section of Physics of the Paris Academy of Sciences, in succession to the late Dr. C.-E. Guillaume; I. Holmgren, from 1913 to 1936 professor in the Caroline Medico-Surgical Institute at Stockholm, has been elected correspondent for the Section of Medicine and Surgery, in succession to the late Professor I. Pavlov; M. Paul Wintrebert, professor of comparative anatomy and histology in the Sorbonne, has been made a member of the Section of Anatomy and Zoology, in succession to the late F. Mesnil.

Dr. Charles E. Spearman, emeritus professor of psychology at the University of London, has been elected a member of the German Academy of Natural Sciences at Halle.

Dr. Albrecht Penck, professor of geography at the University of Berlin, has been elected an honorary member of the Geological Society at Berlin.

The degree of doctor of humane letters will be conferred by Hamilton College on Dr. Gustav Eckstein, professor of physiology in the College of Medicine of the University of Cincinnati.

The National University of Ireland has conferred the doctorate of laws on Sir Walter Langdon-Brown, emeritus professor of physic at the University of Cambridge. The degree was conferred by E. de Valera, prime minister, the chancellor of the university. Professor Henry Moore, in an introductory speech, said that "while Sir Walter Langdon-Brown's name was familiar to every member of the medical profession through his medical writings and lectures, his repute was high in literary and scientific circles through his philosophical and scientific works."

Dr. Malcolm Goodridge, professor of clinical medicine at Cornell University Medical College and attending physician at New York Hospital, was installed as president of the New York Academy of Medicine at the annual meeting of the academy on January 5. He succeeds Dr. James Alexander Miller.

Sir Robert Robinson, Waynflete professor of chemistry at the University of Oxford, has been nominated for the presidency of the Chemical Society, London.

Dr. Julius Bauer, professor of internal medicine and since 1931 in charge of the department of medicine at the University of Vienna, has been appointed clinical professor of medicine in the School of Medicine of the Louisiana State University.

Dr. Henry Pinkerton, assistant professor of pathology at Harvard University, has been appointed professor of pathology and director of the department at St. Louis University. Dr. William Bauer, professor of dental pathology at the University of Innsbruck and director of the Dental Clinic, has been appointed professor of dental pathology.

Dr. George F. Stewart has been named research associate professor of poultry husbandry at Iowa State College. He will work on problems of the cold storage of eggs and poultry meat in the Iowa Agricultural Experiment Station.

Dr. Ulysses P. Hedrick, who retired as director of the New York State Agricultural Experiment Station in January, 1938, has been given the title of director emeritus of the station.

Frank T. Bell, who has been commissioner of the Bureau of Fisheries for five years, will retire on March 21.

Dr. Vannevar Bush, president of the Carnegie Institution of Washington, previously vice-president and dean of engineering of the Massachusetts Institute of Technology, has been elected to life membership on the corporation of the institute.

Professor Elmer A. Starch, a member for the last twelve years of the department of agricultural economics of the Montana State College and now director, has been appointed coordinator of programs for the U. S. Department of Agriculture. He took up the work on January 1.

Earl Church, associate professor of photogrammetry in the College of Applied Science of Syracuse

University, has been appointed a member of the Advisory Board on Maps and Surveys by the New York State Planning Council.

DR. FLOYD K. RICHTMYER, professor of physics at Cornell University and dean of the Graduate School, has been elected secretary of the Association of American Universities for a five-year term. Heretofore, the officers of the association have been assigned to universities and not to individuals.

DR. ARNO VIEHOEVER, research professor of biology at the Philadelphia College of Pharmacy and Science, has been made scientific adviser to the Government of Siam. While there he will be affiliated with the Ministry of Economic Affairs and with Dr. Toa Labanukrom, director general of the Department of Science. He will organize and direct a special research unit, to explore and utilize domestic curative and nutritional agents.

DR. HARRY PLOTZ, of the Pasteur Institute, Paris, has been appointed chief of service in charge of virus research.

SIR RICHARD GREGORY, retiring editor of *Nature*, who has been visiting the United States at the invitation of the Carnegie Institution of Washington, sailed for England on January 5. Sir Richard delivered the Elihu Root lecture at the institution on December 8 on "Cultural Contacts of Science." While in the United States he gave addresses before a general session of the American Association for the Advancement of Science at Richmond, at Harvard, Columbia and the Johns Hopkins Universities, and elsewhere.

DR. G. C. ANDERSON, secretary of the British Medical Association, sailed on December 28 for a tour of the West Indian branches of the association. He will visit Barbadoes, Grenada, Trinidad and Jamaica, and will return to England about the beginning of March. Dr. Anderson's visit, it is stated, is in conformity with the policy of the association of maintaining personal contact as opportunity offers with its branches overseas.

DR. C. P. MCMEEKIN, of Mercer Agricultural College, New Zealand, recently inspected experimental work being done at the Agricultural College at Davis of the University of California and lectured to staff members of the division of animal husbandry. Dr. McMeekin has been working at the University of Cambridge during the past year.

FORMER PRESIDENT HERBERT HOOVER and Dr. Harvey N. Davis, president of the Stevens Institute of Technology, will be guest speakers at the thirty-sixth annual reunion dinner of the Alumni Association of the institute, which will be held on January 30 at the Hotel Astor, New York City.

DR. EDWIN J. COHN, professor of biological chemistry at the Harvard Medical School, will deliver the fourth Harvey Society lecture of the current series at the New York Academy of Medicine on January 19. Dr. Cohn will speak on "Proteins as Chemical Substances and Biological Components."

DE LAMAR LECTURES of the School of Hygiene and Public Health of the Johns Hopkins University will be given on February 14 by Dr. G. R. Minot, professor of medicine at Harvard University, on "Anemia," and in April by Dr. Edward Stuart Russell, director of Fishery Investigations, Ministry of Agriculture and Fisheries, London, honorary lecturer in animal behavior at University College, on "Fish Populations and the Effect of Fishing." Previous lectures in the present series were given by Dr. Rupert B. Vance, research professor, Institute for Research in Social Science, University of North Carolina; Dr. Carl Ten Broeck, The Rockefeller Institute for Medical Research; and Dr. Martha Eliot, assistant chief of the Children's Bureau, U. S. Department of Labor.

THE annual joint meeting of the Institute of Radio Engineers and the International Scientific Radio Union (American section) will be held at Washington, D. C., on April 28 and 29. Other scientific societies meeting in Washington during the same week include the National Academy of Sciences, the American Physical Society and the American Geophysical Union. Papers on the more fundamental and scientific aspects of radio will be presented. The program will be published in the April issue of the *Proceedings* of the Institute of Radio Engineers. Titles of papers available for presentation should be submitted to the committee not later than February 21. It is desirable that abstracts of not over 200 words be submitted with the titles. Correspondence should be addressed to S. S. Kirby, National Bureau of Standards, Washington, D. C.

DISCUSSION

THE UTILIZATION OF MICROFILMS IN SCIENTIFIC RESEARCH

THE procedure usually followed by research workers in collecting information upon a given subject is to peruse first the abstract journals and, having obtained references to previous work, to consult the original papers. Since scientific periodicals can usually be found only in libraries and must be read there or borrowed only for brief periods, it is necessary to make extensive notes or copy as much of each paper as may be desired for future use.

Occasionally it will be possible to obtain reprints of some of the original papers, hence the research worker may assemble upon a given subject quite a variety of printed papers and hand-written notes. To these it is now becoming necessary to add the new and entirely different microfilm records which are becoming available in increasing quantities.

Microfilms are photographs in reduced size upon 35 mm moving picture film, of the printed pages of bound and unbound volumes. They have been made since November, 1934, by Bibliofilm Service of Washington. This non-profit organization is conducted by cooperative agreement in the libraries of the U. S. Department of Agriculture, Army Medical, Geological Survey and Bureau of Standards. The price is 1 cent per page plus 20 cents service charge for each article copied. They can be read by means of a small hand magnifier obtainable from Science Service of Washington for $1.50 or with the aid of a highly perfected desk projector, which was developed by cooperation between Science Service, the Chemical Foundation, the U. S. Navy and others, and is now available commercially at about the price of a typewriter.

The greater part of original scientific research is published in the form of brief accounts, not exceeding ten pages in length. Such reports may usually be copied upon less than five microfilm spaces of a total length of about 8 inches. Thus one obtains relatively short lengths of film which it is necessary to file with a variety of printed and written records.

Since the text reproduced upon microfilms can not be read with the naked eye, it is necessary to provide classifying information or notes in regard to each film, in characters which can be read directly. If this information is written upon sheets of paper and the film itself fastened to these sheets, they may be filed with similar records in whatever manner is most convenient, without loss or displacement of the film. In those cases where the length of the film is greater than that of the paper, it may be cut in two or more pieces. The reading magnifiers and projectors now available have film holders in which even very short lengths of film may be inserted, and the perforations along their edges provide convenient holes for fastening the several short pieces to their classifying sheet.

By this method microfilm can conveniently be filed and kept in exactly the same manner employed for other such records. They therefore not only offer no unusual difficulties in respect to their use and conservation, but provide far more complete and compact records than can be assembled in any other way.

One of the principal advantages of microfilms is that they relieve the research worker of the task of making transcriptions of the original literature. The inconvenience arising from errors or incompleteness in such records is entirely avoided. With a microfilm copy at hand it is never necessary to make a second trip to the library or borrow the periodical for completing the notes previously made.

Another very great advantage is that they permit one to make the detailed study of each paper in connection with all the others collected upon the same subject, instead of requiring that this study be made at the time the paper is available for preparing the digest or transcript of it for future use.

By means of microfilms one is relieved of the fatigue incident to assembling and handling large numbers of heavy and unwieldy volumes. Furthermore, since these volumes do not leave the library, no one who desires to consult them there is ever deprived of their use. With a complete collection of microfilm copies of all available papers upon a given subject, one is independent of further library service. Since, unlike books, they do not have to be returned, it is never necessary to hurry or slight one's examination of any paper, especially those which it is necessary to study with unusual care.

The compact form of microfilms makes it possible to take them, together with a small microfilm viewer, wherever one goes and consult them at whatever time or place is found most convenient. Thus one may profitably make use of spare moments which otherwise could not be devoted to the research problem upon which he happens to be engaged.

Microfilms offer the best possible method for making extensive compilations of scientific literature. They permit the complete assemblage of all pertinent reports before their critical study and arrangement of the facts in the logical order required for their presentation. It was only through their use that the writer found it possible to undertake a fourth revision of his compilation of "Solubilities of Inorganic and Organic Compounds." The literature on this subject is so extensive that its collection, classification and editing would have been a task beyond his power without the aid of microfilms.

Finally, not the least of the advantages of microfilms is their very modest cost to the individual. In fact, up to the present, those who have made use of the Bibliofilm Service operating in the library of the U. S. Department of Agriculture, have received microfilms at considerably less than their actual cost. Fortunately for the progress of research, the Chemical Foundation and both the Rockefeller and Carnegie Foundations have recognized the advantages of microfilms to the advancement of science, and have generously contributed to the expenses of developing and operating Bibliofilm Service. It is expected that with the continued expansion of the Service the present low price will be sufficient to cover the actual cost of furnishing microfilms to research workers.

Microfilm copying such as has been developed by

Bibliofilm Service now operating in four Washington libraries puts at the disposal of every one doing serious research the resources of the most complete collections of scientific literature in the United States. From the standpoint of original literature microfilms places those doing research in the most isolated institutions on an equality with those working in immediate proximity to complete collections of scientific periodicals. It may be expected therefore that many who have hitherto been prevented from undertaking research for want of proper library facilities, will now find it possible to devote themselves to the numberless scientific and technical problems awaiting solution.

ATHERTON SEIDELL

NATIONAL INSTITUTE OF HEALTH
WASHINGTON, D. C.

IMPROVEMENT OF SCIENCE INSTRUCTION

THE American Association for the Advancement of Science Committee on the Improvement of Science in General Education[1] held a meeting at Chicago on December 3 and 4, on one aspect of which a preliminary report has already been made.[2] Some of its findings may be of interest to readers of SCIENCE.

Of 2,565 inquiries sent out last May, seeking information on what college and university teachers of science were thinking and doing about adapting their offerings to the requirements of *general education,* in distinction from *specialist education,* more than 1,200 replies had been received. Eleven hundred of these had been analyzed to date, yielding, among other things, the following information.

Of those replying, 64 per cent. were doubtful or more than doubtful about the value of the conventional introductory college courses in the various sciences to non-majors. 70 per cent., however, feared that attempts so to modify first-year courses as to make them of greater value to non-majors might be attended by the danger of making the courses superficial.

There seemed, nevertheless, to be little disposition to maintain the *status quo,* for 86 per cent. had made changes in their introductory courses within the last five years, of sufficient extent to justify report.

Insufficient motivation for a study of teaching problems seemed to be regarded as a handicap, for 62 per cent. felt that the disproportionate emphasis placed on publication of results of "pure research" as a basis for professional recognition and advancement had retarded the development of a real concern about and research upon teaching problems in the introductory courses in the sciences.

77 per cent. expressed the need for a discussion and clarification of the issue of the place of science in general education at the college and university level. The fact that only a little over one third of a mature group of college teachers of the sciences possesses unqualified confidence in the value of the traditional first-year courses to non-majors raises several questions. What do they think is wrong with these courses? Along what lines would they undertake improvement? What has brought about their impression of the inadequacy of the first-year science courses to the purposes of general education? These are not easy questions to answer, but the committee is deeply concerned with ways and means of trying to answer them.

Questionnaires are notoriously "slippery" ways of acquiring information, and it was only after some hesitation that a questionnaire was utilized as a first probe, primarily because it was the quickest way of getting started. Other channels of information are being opened up. Special visits have been made by representatives of the committee to 115 science departments where significant experimentation on teaching methods seemed to be under way. An extended bibliography of publications on the relation of the sciences to general education, indexed and annotated, will be prepared for the use of the committee. In addition, as indicated in previous communications, the committee solicits correspondence with any who have teaching experiments under way or who are contemplating such.

Perhaps it should be emphasized that this committee's primary responsibility is to chart the field; only secondarily, if at all, to try directly to solve the problems therein. Some of the problems which loom are, in fact, beyond the ability of any one group to cope with. Hence the wisdom of the founding committee of the American Association for the Advancement of Science, which provided, among other things, that this committee should clarify and define the problems involved in teaching the sciences as a part of the program of general education; serve as a clearing house for coördinating the activities of the several agencies now at work on parts of the whole problem as well as new agencies which may be initiated for the improvement of science teaching; act in an advisory capacity on any studies approved by it and supported through it; require and coordinate reports of such studies and provide for publication of the findings.

LLOYD W. TAYLOR

OBERLIN, OHIO

THE BENLD METEORITE, ILLINOIS NO. 2

ON September 29, 1938, between the hours of 9:00 and 9:10 A.M. occurred the second meteorite fall ever to be recorded within the state of Illinois. This important event took place in the south edge of the town of Benld, Macoupin County, near the southeast corner of the S W ¼; S W ¼; Section 31, Township 8 North; Range 6 West of the 3rd P.M. (89° 48′ 52″ ± W. Long.; 39° 05′ 14″ ± North Lat.)

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[1] SCIENCE, 87: 454, 1938.

[2] SCIENCE, 88: 588, 1938.

In falling this meteorite penetrated the roof of a frame garage and the top of a Pontiac coupe therein, making a neat hole in the cushion of the car to the right of the driver's seat. It also broke the floorboard beneath the seat, and made a slight dent in the car's muffler. The meteorite itself, however, did not hit the ground, as it had become so entangled in the springs of the cushion that it was snapped back up into the cushion by the recoil of the springs.

When discovered and retrieved by the owner the same afternoon, it was found to be roughly prismatic (almost rectilinear) in outline, with dimensions of approximately 110 × 90 × 80 mm. It weighed 1,770.5 grams in air, (after two small fragments of undetermined weight had been removed), and possessed a S. G. of 3.69. Its outer surface was entirely covered with a jet black velvety crust from ½ to 1 mm in thickness. Its interior exhibited a dark gray surface, with chondrules well developed, speckled freely with bright metallic grains of a silvery luster. From weight and appearance it would classify as a typical aërolite.

By the perfect alignment of the holes made in the roof, car and seat, the final end course of the meteorite was determined to be 64° 46′ east of north and at an elevation of 77° 31′ above the horizontal (12° 29′ from vertical). Until more distant observations on its course are obtained, the announcement of its positive direction, radient and velocity must be held in abeyance.

The property upon which the meteorite fell belongs to Mr. Edward McCain, which makes him the owner of the specimen. While it landed with a roar which sounded like "an airplane going into a power dive, and ending in a crash," no one has been interviewed who actually observed its passages through the air. It struck, however, within approximately fifty feet of Mrs. Carl C. Crum, who was working in her yard, just across the alley, at the time. She reported that she could see no smoke clouds and observed no fumes. Thinking that a "plane" had crashed into the rear of their barn, Mrs. Crum rushed out into the alley, and was greatly perplexed on finding no apparent damage to the building. The roof of the garage through which the stone actually fell was so oriented with respect to her position that she was unable to see and observe the hole in the roof from the spot where she was working.

The sound was also heard by Mrs. McCain, who was out pumping water at the time, but somewhat farther from the garage. Several neighbors who were indoors also heard what they took to be an airplane passing over, but "thought nothing of it." This occurrence is certainly unique in several respects, as we believe it to be the first authentic case of any meteorite ever striking an automobile, or for that matter a vehicle of any kind; and the first where its end course could be accurately measured from three established points penetrated in its fall. We also believe Mrs. Crumb came nearest to being actually hit by a meteorite of any person on record in this country. So far as is known, this was a lone individual stone, there having been, to date, no report of others having fallen in the vicinity at the time.

BEN HUR WILSON

JOILET, ILL.

WHAT DID THE BLUE JAY DO WITH THE NUT?

THIS afternoon (November 21) I observed the following quick sequence of events, which occurred on my front lawn:

1:45. A grey squirrel, answering my tapping signal, ran up a rustic incline which leads to a window box, to secure a nut (paper shell pecan) which I offered him through an open window.

1:46. This squirrel scampered back to the lawn to a point about 15 feet away. He buried the nut and raked a brittle oak leaf over it.

1:47. The squirrel returned to the window box for a second nut. Immediately a blue jay flew down to the precise spot where the first nut had been buried, pecked vigorously through the oak leaf into the soil, and in about 30 seconds seized the nut in his bill and disappeared with swift and sudden flight into a towering elm near by. What did he do with the nut?

I do not wish to worsen the reputation of the blue jay, but the incident seems worth reporting.

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SPECIAL ARTICLES

MAMMARY CARCINOMA IN THE RAT WITH METASTASIS INDUCED BY ESTROGEN*

IN a previous communication pathologic changes in the mammary gland of the rat induced by estrogen and other hormones have been reported and an early comedo carcinoma of the mammary gland illustrated in a castrated female injected with 200 gamma of estrone.[1] The changes in this animal were not discussed, however, because confirmation of the diagnosis of cancer was lacking at the time. Since this communication mammary cancer in the rat has been in-

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* Aided by grant from the Anna Fuller Fund.

[1] E. B. Astwood and C. F. Geschickter, *Arch. Surg.*, 36: 672, 1938. Figs. 8 and 10 are whole mounts and paraffin section depicting early adenocarcinoma. The legends compare the condition to a phase of Schimmelbusch disease in the human.

duced in 26 animals. The animals used were a pure strain of albinos, fed on a standard diet. They have been maintained by breeding in this laboratory since 1934 and to date in a colony of 2,000 rats, spontaneous mammary cancer has not appeared in untreated animals. Cancers have been obtained in both male and female castrates and noncastrates, with varying amounts and methods of dosage and metastasis to the lungs and mediastinal lymph nodes has been obtained. The protocol of one of these rats is given below:

Rat number 1274—Born November 22, 1937—Female not castrated.

Fifty gamma of estrone daily (excluding Sundays) November 23rd to December 29th (37 days).

Twenty-five gamma estrone twice daily (excluding Sundays) December 30th to March 21st (70 days).

Estrone pellet 4 milligrams March 21st.

Estrone pellet 2 milligrams June 16th, 1938. Autopsied November 3rd, 1938 (346 days old).

The entire abdominal wall was covered by mammary tumors for a period of over six weeks prior to death. Sections of the mammary cancer show areas of adenocarcinoma arranged in coils and lining duct channels. The epithelial cells are oval and compressed and contain numerous mitotic figures. In places the cancerous epithelium is more of the transitional type and in other areas shows squamous cell metaplasia. Nearly all the mammary tissue is replaced by cancer. The mediastinal lymph nodes are in a large measure replaced by solid cancerous tissue. The lungs in addition to terminal pneumonia show numerous small metastases similar to the primary tumor.

The uterus is lined by epidermoid tissue; the canal is dilated, but there is no pyometrium. The lining of the fallopian tubes is hyperplastic and there is an adenoma at the fimbriated ends of both tubes, probably in the parovarian. The ovaries are atrophic and show minute follicles. The transitional lining of the renal pelvis is thickened; the kidneys are otherwise negative. The adrenals showed atrophy of the external cortical layer, and the pituitary showed a large chromophobe adenoma. In the gross the hypophysis was about three times its normal size. The other organs were essentially negative.

In the present series of experiments 85 rats were subjected to various types of estrogenic treatment, the chief object being to determine the nature of the changes preceding the formation of mammary cancer and the most effective method of producing mammary carcinoma in the rat.

These experiments (see Table 1) indicate that a daily dosage of 200 gamma of estrone injected intramuscularly is most suitable for the detailed study of the mechanism of cancer production in the mammary gland of the rat. Microscopic cancer occurs within 150 to 200 days with such dosage.

TABLE 1

MAMMARY CANCERS IN THE RAT PRODUCED BY ESTROGEN

Experiment number	No. of rats*	Estrone dosage	Number of cancers produced	Age at beginning of treatment	Days required to produce cancer
1	4†	50 gamma daily	3 males	26 days	534–565
2	8†	100 gamma daily	3 males 1 female	37 days	359–400
3A	13†	200 gamma daily	5 females	21 days	150–200
3B	4†	200 gamma daily plus testosterone	1 female	25 days	191
4A	28‡	25 gamma twice daily plus pellets	6 females	1st day	150–247 17 still living
4B	18†	25 gamma twice daily plus pellet	4 females	1st day	208–240 7 still living
5	11‡	Pellets	2 females	1st day	23–43 11 still living
	86		19 females 6 males	Earliest cancer in 23 days	

* Includes males and females.

† Castrated.

‡ Not castrated.

Pellets are crystalline estrone in 2 to 3 milligram amounts. Experiments 4A and B and 5 are still in progress, the animals being between the 205th and 400th day of treatment. The cancers listed are only those which have been microscopically studied. The estrone used was ketohydroxyestrin supplied by E. R. Squibb and Sons.

Cancer can be produced by the injection of smaller doses in 500 to 600 days with 50 gamma and in 350 to 400 days with 100 gamma. They can be obtained more quickly by implanting the crystalline hormone in the form of pellets (25 to 50 days).

With injections of the hormone in oil once daily, the time required is inversely proportional to the size of the dose, the total dose being relatively constant. With the use of pellets a higher and more constant rate

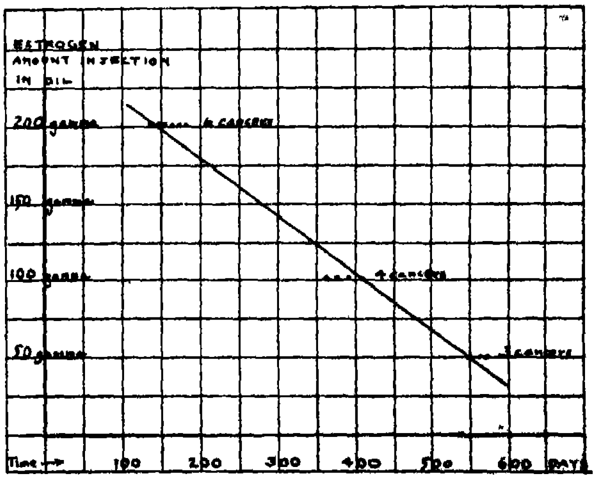

FIG. 1. Chart showing that the time of appearance of mammary cancer in the rat is inversely proportional to the amount of estrogen injected daily subcutaneously in oil.

of absorption is obtained and the cancer is produced sooner and with a smaller total dose. With pellets a total of five to ten milligrams is sufficient, whereas with injections in oil a total of 30 to 40 milligrams is used.

In a parallel group of experiments, an attempt has been made to induce mammary carcinoma of the rat with other estrogenic substances. The compounds used have been estradiol, estradiol dipropionate and diethylstilboestrol. The experiments are still incomplete but cancer has been obtained in one rat injected with 200 gamma of diethyl-stilboestrol daily for 100 days. This cancer induced with diethyl-stilboestrol is significant because the substance has the physiological action of estrone but is not a sterol. This suggests that the mammary cancers induced in the rats by the injection of estrogenic substances are due to the physiological changes produced rather than to the cancerogenic nature of the chemicals used.

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FUMARIC ACID FORMATION ASSOCIATED WITH SEXUALITY IN A STRAIN OF RHIZOPUS NIGRICANS

A DEFINITE relation has been known for some time to exist between the sexuality of fungi belonging to the *Mucorales* and certain biochemical reactions exhibited by them. Thus Satina and Blakeslee[1] demonstrated a high degree of correlation of the sexual nature of these fungi with such properties as reducing power of cell extracts toward $KMnO_4$ and tellurium salts, Manoilov's reaction, catalase content, etc. On the other hand, these authors could not establish any differentiation based on the carbohydrase systems of the various races. The differences in reactions obtained for the male and female races were in almost all cases quantitative rather than qualitative.

The present note concerns one strain of *Rhizopus nigricans* whose male and female races are distinct by virtue of the *possession or the complete lack of a certain specific physiological mechanism,* namely, the enzyme system by which the organism produces fumaric acid when grown on a glucose-mineral solution (Table I). So far as the authors are aware no similar case has yet been reported. The male race (−) was tested under a variety of experimental conditions and never was found to form fumaric acid, whereas the female race (+) produced this acid abundantly. Further, despite the fact that a large part of the glucose consumed was transformed by the plus race into fumaric acid, this organism was able to utilize the energy much more efficiently and synthesize much more cell substance than its male homologue, as measured by nitrogen consumption.

The ability to form fumaric acid is but one of the many specific reactions of which this group of fungi is capable, and it is not impossible that sexual differences within this group may eventually be correlated with other as yet unstudied physiological processes. It must not be inferred, however, that the above results are characteristic of all or even a significant number of sexual pairs of *Rhizopus;* another pair tested simultaneously yielded no such dissimilarity and even members of the same race differed in this respect. This would seem to indicate that fumaric acid formation is not at all a property specific to a race but may rather be attributed to some biological characteristic giving rise to strain specificity.

TABLE I

FUMARIC ACID PRODUCTION BY MALE (−) AND FEMALE (+) RACES OF A STRAIN OF RHIZOPUS NIGRICANS*

	Female race (+)	Male race (−)
Glucose consumed, gm.	6.472	6 662
Fumaric acid produced, gm.	2 059	0
Conversion, per cent.	31.8	0
NH_3–N consumed in culture, mgm.	80.7	40.6
Calcium in solution due to organic acids, mgm.	722.1	49 6
Fumaric acid equivalent, calculated from Ca^{++}, gm	2.094	.....
Per cent. of total acid as fumaric	98.3	.....

* Medium used · 200 cc portions of 5 per cent glucose-mineral solution containing 82.0 mgm NH_3–N; incubation, 15 days at 28° C.

A detailed study of the process of fumaric acid production and its possible function in the mechanism of energy utilization by different species of *Rhizopus* will be published shortly.[2]

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GAS BUBBLES AS NUCLEI FOR "OOLITES"[1]

SPHERICAL bodies of calcium carbonate, with some of the characteristics of oolites, are now forming in a swimming pool supplied with water from one of the Pinkerton Hot Springs in southwestern Colorado. Five large springs and several smaller ones occur within an area of about a quarter of a square mile on the west side of the Animas River, about 12½ miles north of Durango. They appear to issue from fissures in the Ouray limestone, but the points of emergence are obscured by cones of travertine that have been deposited by the spring waters. The year-round temperature of about 87° F.[2] and the uniformity of flow regardless of seasonal variations in precipitation indicate that the water rises from considerable depth.

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[1] S. Satina and A. F. Blakeslee, *Proc. Nat. Acad. Sci.,* 12: 191–96, 197–202, 1926; 13: 115–22, 1927; 14: 308–16, 1928.

[2] The authors are indebted to Dr. A. F. Blakeslee for supplying cultures used in these investigations.

[1] Published by permission of the Director, Geological Survey, United States Department of the Interior.

The spring waters contain large amounts of calcium bicarbonate and salt (sodium chloride) and considerable quantities of other constitutents. The figures in Table 1 are an average of two very similar analyses of waters from two of the springs.

TABLE 1

COMPOSITION OF WATER FROM PINKERTON HOT SPRINGS*

Constituent	Milligrams per liter (Approximately parts per million)
Silica (SiO_2)	37
Ferric oxide + alumina ($Fe_2O_3 + Al_2O_3$)	Tr. – 14.1
Calcium (Ca)	513
Magnesium (Mg)	37
Sodium (Na)	665
Potassium (K)	100
Bicarbonate radicle (HCO_3)	1,255
Sulphate radicle (SO_4)	636
Chloride radicle (Cl)	945
Total dissolved solids	3,805
Excess carbon dioxide (CO_2)	453

* H. A. Curtis, in R. D. George, *op. cit.*, pp. 291–292.

The water from one of the springs is led through an iron pipe into a large concrete-lined swimming pool. Calcareous tufa, stained yellowish brown with iron oxide, is deposited rapidly and by the end of the summer tourist season, which lasts from June through September, the walls and floor of the pool are coated with 6 inches or more of the material. The pool is scraped clean once a year.

"Oolites" were found forming along the sloping floor of the pool in the early summer of 1935. They were most abundant where the water was less than 6 inches deep. They ranged from a fraction of a millimeter to about 2 millimeters in diameter and consists of film or skins of calcium carbonate that enclosed bubbles of gas, almost certainly carbon dioxide. The precipitate was very thin or absent on the tops of the mineral "balloons," but thick below. Many of the growths assumed the shape of tiny wine glasses, with slender stems 2 to 3 millimeters in height supporting the gas bubbles which were wholly or partly enclosed by calcareous material. The balloon-like bodies that were not attached to stems were easily detached from the floor of the pool, when they rose to the surface and almost invariably burst. The slight but almost constant agitation of the shallow water thus tended to prevent the formation of thick-walled or solid oolites.

Late in the summer, after the pool was drained, it was found that the "oolites" also formed in running water. At that time the spring water was allowed to run across the floor of the pool to a lower outlet. "Oolites" formed about gas bubbles in shallow pools and eddies along the sides of the stream, where agitation was at a minimum. The constant movement caused most of the structures to break soon after formation, however.

The gas bubbles were undoubtedly formed because of cooling and slight evaporation of the water which reduced the solubility of the carbon dioxide gas in the water. The bursting of the shells when they reached the surface may have been due to the sudden agitation, to the slight change in pressure, or to rapid partial drying on exposure to the air. No explanation is offered as to the mechanism that caused the formation of pedestals or the fact that most of the shells were thinner on top than on the bottom.

The occurrence has some bearing on the origin of oolites. Calcareous oolites are reported to form about gas bubble nuclei off the Florida coast.[3] The thin spherical coatings of calcium carbonate at Pinkerton also form about gas bubbles. It seems possible that under certain conditions these coatings could persist long enough to develop thick walls and thus become true oolites. The occurrence shows conclusively that some spherical bodies form without mechanical agitation, a conclusion at variance with that reached by some of the geologists who have studied oolites. At Pinkerton the "oolites" form both in quiet and in slowly moving water.

EDWIN B. ECKEL

U. S. GEOLOGICAL SURVEY

THE RELATION OF MAXIMUM CRUSHING STRENGTH OF WOOD TO THE DEGREE OF SWELLING INDUCED BY VARIOUS CHEMICALS[1]

THE object of these experiments was to determine the effect of a number of chemicals upon the strength of wood and the relationship of the latter with the swelling caused by the chemicals. Sets of small blocks of Norway pine sapwood (*Pinus resinosa*) were oven dried, measured and placed in various organic liquids, mostly alcohols. Other sets of blocks were not oven dried, but the moisture content was raised above the fiber saturation point; the blocks were measured and then injected with various aqueous solutions. After the proper time the following results were obtained:

An inverse correlation of crushing strength with swelling was found for wood which was saturated by various organic liquids. The organic liquids did not weaken the wood to the same extent that water did for any given amount of swelling from the oven-dry condition. The intensity of swelling declined as the alcohol molecules became more nearly hydrocarbon in constitution. More than 120 days were required for the swelling of wood to reach equilibrium in n-butyl alcohol.

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[2] R. D. George, *Colo. Geol. Survey Bull.*, 11: 291–292, 1920.

[1] The experimental work was done at the Division of Forestry, University of Minnesota. The project was completed at the Division of Forestry, West Virginia University.

[3] T. W. Vaughan. Florida studies, Carnegie Inst. of Wash., Year Book 11, 157–158, 1913.

Increased swelling beyond water-swollen dimensions by concentrated aqueous solutions did not necessarily cause decreased crushing strength. The chloride salts increased strength and swelling, although not in proportion to concentration or swelling. Thiocyanate and iodide salts, on the other hand, caused decided swelling but decreased strength, as did also resorcinol, pyrogallol and urea solutions. Chloral hydrate increased the crushing strength by about 40 per cent., yet caused the greatest swelling. Some radial contraction occurred in several aqueous solutions.

The experiments indicated that decreasing crushing strength of wood by organic liquids was associated with increased swelling. The strength of wood in concentrated aqueous solutions apparently was not governed by this standard. In both cases, specific effects of the chemicals on the wood were important. A detailed report will appear in another journal.

H. D. ERICKSON

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLE METHOD FOR FILING MINIATURE NEGATIVES AND MICROFILM RECORDS IN STRIPS

THE increasing use in scientific work of miniature cameras and of microfilm records makes the problem of film storage of considerable importance. I venture, therefore, to describe a simple and inexpensive method for filing films of the smaller sizes.

Film negatives of 35-millimeter size are in my experience more easily handled in the enlarger if they are cut into strips than if they are kept in the long rolls. In particular there is less likelihood of the negatives in the strips acquiring finger marks and scratches.

Records copied on microfilm may also be kept conveniently in strips. It is much simpler to remove the desired strip from its storage pocket than it is to unwind a long roll of film and then to find on it the particular frame needed for consultation. On microfilm copies of scientific papers or books kept in strips any particular page is easily found. Some types of readers for microfilm handle the strips equally as well as the rolls, but it is possible that not all types of readers will handle the strips.

For filing strips of miniature film, stationers' envelopes, size No. 10, are very satisfactory. These envelopes measure 4⅛ by 9½ in size and are therefore long enough to take film strips made up of 6 double-frame negatives of 35-millimeter size. Each envelope is divided inside into a number of compartments by paper partitions. A sheet of paper 3⅞ by 9⅜ inches is just right to make a single partition. By the use of these dividing sheets all the film strips cut from one roll of 35-millimeter film may be stored in a single envelope. The usual roll of 36 exposures will require 5 partitions.

Papers or books copied on microfilm are usually arranged so that 2 pages go on a double-frame negative. A film strip of 6 double frames will therefore contain 12 printed pages. A book of 96 printed pages will, accordingly, go on 8 of these strips, which will not unduly crowd a single envelope. Most scientific articles are much shorter than this. Microfilm copies of books over 100 pages long will require 2 or more envelopes.

In the envelopes provided with paper partitions each film strip is kept in a separate paper compartment with no danger of rubbing against any other strip. When a film strip is to be removed from the envelope it is picked up by its uppermost edge. The unused margin of the film is of course wide, for it contains the perforations. If the strip is handled carefully no finger prints need ever be made on a negative.

The envelopes described can be obtained at a small cost from any stationer. If a standard size of envelope and standard grade of paper are chosen there should be no difficulty in future purchases in duplicating either the size of the envelope or the quality of paper. The paper for the envelopes and for the inside partitions should be of good quality linen. A poor quality of paper is likely to deteriorate rapidly and it may contain injurious chemicals. In damp climates the gum on the flap may inadvertently seal the envelope. To avoid this the gum can if desired be removed with a damp cloth.

The best time to cut the film into strips is as soon after development as it is dry. If the film has been kept rolled for some time it will have strong tendency to curl. However, if the film strips are placed in an envelope and then the envelope placed under a book or other weight for a few days the tendency of the film to curl will gradually be lost.

In cutting the roll of film into strips one should if possible divide it into lengths of 5 or 6 exposures each. Strips containing 4 exposures are also satisfactory, but I find that strips containing only 3 exposures are less easily handled in the enlarger or microfilm reader than are the longer strips. The inclusive frame numbers or page numbers for each strip should be marked in pencil on the upper edge of the paper partition behind the strip.

On the front of each envelope may be written data referring to the whole roll of film which it contains. These data may include catalogue number or other designating mark of the roll, date and place of taking, photographer, kind of film, type of developer and ony other pertinent information.

Sheets of paper giving catalogue data, printing time for each negative or any other notes may be placed in the same envelope with the film. These data sheets are best made slightly smaller than the envelopes so that they may easily be inserted or removed. A convenient size is 3⅝ by 8½ inches.

Film strips of any of the smaller sizes can be kept in the envelope described above. In a No. 10 envelope any width of film up to 3¼ inches can be accommodated. Envelopes containing films of different widths may of course be filed together.

The envelopes containing the film strips may be grouped into packages by placing moderately heavy rubber bands around them. Sheets of cardboard the same size as the envelopes and placed on each side of the package will protect the edges of the envelopes from undue wear. The pressure of the rubber bands will keep the film strips contained in the envelopes flat.

The packages of envelopes with their enclosed film strips may be filed in any manner desired, either in boxes or drawers. They fit nicely lengthwise in the drawers of filing cabinets designed for 4 by 6 cards.

The ease with which the film strips are inserted into and removed from the envelopes, the excellent protection given the film, the cheapness of the envelopes and the possibility of keeping as much data as may be needed with the negatives or microfilm records are the advantages of this simple method of filing films.

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CONTROL OF MOLD IN FOOD FOR DROSOPHILAE

IN many genetics laboratories where Drosophilae are used for breeding purposes food is still made with bananas as one of the principal ingredients. Banana food molds easily, and when it is kept for more than a day or two the mold usually gets started before the flies have time to produce larvae. The result is that often the flies do not breed well. In this laboratory molds of various species are exceptionally abundant, due largely to climatic conditions. The offenders are usually species of Rhizopus, Mucor and Aspergillus. Conditions have been so unfavorable that a special study was made for controlling molds in general. Contamination seemed to be from various sources, so that more than one method of control was necessary. Food is now made as follows with very pleasing results:

In a pyrex beaker 750 cc of water and 75 cc of white Karo syrup are mixed. To this is added 20 grams of shredded agar. The mixture is boiled until the agar is liquefied. In a separate container two medium-sized bananas are crushed and 25 cc to 30 cc of 95 per cent. alcohol is added. The bananas and alcohol are well stirred and allowed to stand about twenty minutes and are then added to the water-syrup-agar mixture after this mixture has quit boiling and has cooled to about 90 degrees Centigrade. The food amounts to about one liter in volume and is ready for bottling immediately. It is best to autoclave the bottles and cotton plugs, but this is not absolutely necessary. Since alcohol has been added already, it is not necessary to spray the food with yeast, as is done in some laboratories; and since no yeast is present carbon dioxide is not formed. The food adheres well to the bottom of the bottle and the flies do not stick to it easily. It has been kept in this laboraory almost two weeks without being covered with mold; however, when the bottles are not autoclaved contamination may appear within four or five days.

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BOOKS RECEIVED

BUROS, OSCAR K. *Research and Statistical Methodology; Books and Reviews, 1933–1938.* Pp. vi + 100. Rutgers University Press. $1.25.

Comité National Français et Comité National Marocain de Géodésie et Géophysique; Années 1933–34–35–36. Pp. 408. Comité Français, Paris.

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FRAZER, R. A., W. J. DUNCAN and A. R. COLLAR. *Elementary Matrices and Some Applications to Dynamics and Differential Equations.* Pp. xvi + 416. Illustrated. Cambridge University Press, Macmillan. $8.50.

Inventory; An Appraisal of Results of the Works Progress Administration. Pp. 100. Illustrated. The Administration, Washington.

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THE CELL AND THE PROBLEM OF ORGANIZATION[1]

By Professor EDMUND W. SINNOTT

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THE third decade of the nineteenth century may well be regarded as the period in which the science of biology began to assume its modern form. The great conceptions of protoplasm as the physical basis of life, of the cell as the unit of plant and animal structure and of the nucleus as an integral part of the cell were then taking shape in the minds of biologists and were beginning to receive their first published expression. My predecessor of seven years ago celebrated the discovery of the nucleus by Robert Brown in 1831. The present year is generally accepted as marking the centennial of a still more important biological idea, that the cell is the unit of structure in all organisms. It was just one hundred years ago that Schleiden's famous paper was published. We need not attempt here to determine what part of the credit for the formulation of the cell theory should be given to Schleiden and Schwann and how much to earlier students of the minute structure of living things. The year 1838 is at least a convenient point from which to measure a century, and 1938 thus provides a natural occasion on which to evaluate the theory in terms of present-day biology. Such is the purpose of a number of scientific programs, at this meeting of the American Association and elsewhere.

It is not my intention here to undertake the ambitious task of reviewing the significant part which the cell theory has played in the history of morphology, physiology, genetics and indeed of every biological discipline. I do propose, however, to discuss briefly with you certain of its implications for one particular field—that most baffling of biological enigmas, the problem of the organized development of living things. An organism is not static. It continually changes, but in such a regular and orderly fashion that we must recognize in this developmental process the operation of a constant control. The wealth of knowledge which biologists have acquired about plants and animals has thrown surprisingly little light on what this control is or how it is exercised. To watch a fertilized egg or a tiny primordium march unfalteringly onward until the ultimate form of complex organ or body has been attained is an experience common enough among biologists, but it can not fail to impress the thoughtful observer with a sense of his ignorance. Until we shall discover what is really happening in this mass of developing protoplasm, what molding and morphogenetic processes are here so subtly at work, our knowledge of living things will still be merely superficial. This is the biologist's frontier. Beyond is undiscovered country into whose borders a few explorers have penetrated here and there just far enough to see how broad and fertile the land is and how well protected against those who seek to enter it.

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[1] Address of the retiring president of the Botanical Society of America at Richmond, Virginia, December 29, 1938.

It is to this problem of organic development, of course, that the cell theory has made one of its major contributions. To understand that growth is accomplished chiefly by the multiplication of essentially uniform cellular elements and that changes in external form and internal structure are related to differences in the rate and plane of cell division and in modification of the characters of the cells themselves, is evidently to take a long and hopeful step along the road toward a knowledge of the process of development. But we must sadly admit that the hopes raised by this first triumph have not been altogether realized. The developmental relations between cells and the higher structures which they compose are still unknown. The extreme proponents of the cell theory regard the organism essentially as a colony of cellular individuals and attribute the phenomena of development to complex interactions between these units. At the other extreme are the organismalists, who agree that "the cells do not make the body but the body makes the cells." Both admit the significance of cellular organization as either a primary or a secondary factor, but neither has been able to interpret the phenomena of development in any simple or comprehensible terms. The body admittedly is built of cellular units, but the mechanism which controls the multiplication of these units and builds from them before our eyes the amazingly complex organic edifice entirely eludes observation. The most enthusiastic proponent of the cell theory must admit as much.

In an attempt to solve this problem biologists have carried still further the methods of analysis which led to the great generalization which we celebrate to-day. The rather nebulous genetic factors postulated by Mendel have taken material form as genes, and the intensive study which has been given to these new units has yielded much exact knowledge as to their location, and even some idea of their number, size and other characteristics. It is not too much to say that the theory of the gene will play as important a part in the development of our science as did the theory of the cell. Indeed, for many the gene has supplanted the cell as *the* biological unit.

But the geneticist is now beginning to turn his attention to problems of development and encounters here the same difficulty which faces the cellular embryologist. He has learned much about the gene as it occurs in the fertilized egg, primarily through a study of gene-controlled differences in the adult organism; but how the gene is actually related to the development of these traits is still unknown. The spectacular analysis of the cell and thus of the entire organism into an aggregation of genic units has thus far proved no more helpful in solving the basic problems of development than was the earlier analysis into an aggregation of cellular units.

But perhaps the process of subdivision should be carried still further. Students of cytogenetics hopefully discuss the possibility of an analysis of the gene into even smaller units and thus of bringing their problem to the very door of the biochemist. Those who feel content only when their problems can be stated in terms of atoms and molecules look to such an analysis for a final solution, but it is permissible to wonder whether, even if the molecular constitution of every gene were known, we should not still be confronted with the problem of exactly how this elaborate series of units actually gets itself built into what we so well have named an organism.

The repeated failure of these various attempts to solve the problem of organized development by cutting up the individual into smaller and smaller unitary elements breeds the uneasy suspicion that here again, as in so many other scientific problems, we have been confusing analysis with solution. The scientific temperament feels much more comfortable when it is breaking down a complex phenomenon into simpler parts than when it is trying to pull together a series of diverse facts into a unity of relationship. For a solution of the ultimate riddles, however, synthesis is more important than analysis. It is far less easy to come by, and often requires the intuition of genius itself. Thus the progress of chemistry has been marked by an analysis of the material universe into a series of ninety-two different kinds of atoms, which arrange themselves into units of a higher order, the molecules, and are themselves further resolvable into unitary charges of electricity. This was an accomplishment of supreme importance, but Mendelejeff's recognition of orderly relationships between these elements at once made it possible to bring together a wide range of diverse and hitherto unrelated facts into a single integrated system and thus to achieve a far deeper insight into the nature of matter. Similarly, the chief purpose of biology for a long time was to analyze the plant and animal kingdoms into a series of orders, families, genera and species, which seemed to be as arbitrarily arranged as the letters of the alphabet; but Darwin's great synthesis at once made clear that the organic world was not a series of unrelated units but was knit together in the ultimate unity of a common descent. The genius of another Darwin is needed to-day to discover how the complex of molecules, genes and cells are integrated to form a living organism. It is not an understanding of units which we now seek, but of unity. We are like the small boy who takes the clock apart to discover the secret of its running, but after he has dissected the works into an impressive array of wheels, gears and springs is unable to put them together again successfully and is still as far as ever from an understanding of synthetic horology. Like him, we need to know the principles underlying the construction and operation of our machine. Analysis is not enough.

I do not wish in any way to disparage the usefulness of the analytic method or to minimize the very great value of the discoveries which have been made by its means. An understanding of the relations which the products of an analysis bear to each other, however, is quite as essential as the analysis itself. It is important to know that a molecule of water may be resolved into two atoms of hydrogen and one of oxygen, but still more important to know what are the properties and relationships of hydrogen and oxygen which result in the production of a molecule of water when they unite. The analysis has long since been made, but an understanding of the synthesis is still beyond our powers. It is important to know that a living plant is composed of cellular units, but it is even more important to understand how, through the multiplication and interrelations of these units, the orderly development of an organism is assured. The analysis is more than a century old; the synthesis is still far from consummation.

But if the synthetic approach to problems of development is so much to be desired, why in practice has it proven relatively unfruitful? The inherent difficulties of the method and the intractability of the materials to which it is to be applied have doubtless been chiefly responsible. Many biologists have been deterred by these difficulties from attacking the problems or organization at all. Others, despairing of finding a solution through the familiar techniques of their science, have begun to explore the possibilities of ideas and postulates foreign to the familiar biological idiom. The more tender-minded among them have needed little encouragement to run after the strange gods of mysticism and metaphysics and have set up in their midst the golden calf of entelechy. Even those who remain in the ranks of the orthodox speak the unfamiliar language of holism, organicism, metabolic gradients, allometry, organizers, morphogenetic fields, gestalten and other words outlandish in the ear of analytical biology and which for the most part are merely the terminology of enlightened ignorance.

It is not strange, therefore, that many students of development have ceased to concern themselves with what seem to be the fruitless and often demoralizing problems of the synthesis, organization and integration of living things. This defeatist attitude is hard to defend. Granted that the mechanics of development may be among the most recondite of problems, we surely can not admit that it is not open to scientific approach. Granted that it lends itself to fantastic and unsupported speculation and has always attracted the lunatic fringe of our science, yet surely this should not prevent the serious student from applying to its solution the sound and tested methods of biological research. Granted that to coordinate the data of biochemistry, biophysics, cytology, morphology and genetics requires a breadth of training and catholicity of view-point almost impossible to gain to-day, yet the job must be done. My plea is for more laborers in this vineyard. Difficult the task surely is, but by no means hopeless. It should be our chief ultimate concern, for the very autonomy of biology rests upon the phenomenon of organization. Whatever distinguishes the life sciences from the physical sciences lies here, and here we must ultimately succeed or surrender our birthright.

But how can we lay hold of such an elusive and difficult problem? The failure of the cell theory to explain development has at least shown that "Divide and conquer" is a futile strategy to follow in this particular campaign. The easy philosophy that the ultimate task is simply to resolve an organism into its constituent genic or chemical elements and that all else will follow is clearly not enough. Biology is more than biochemistry. Something more profound is required. We must discover the relationships between developmental units and thus the manner in which organized syntheses arise. This task may well be too much for biology alone, and we must nourish no false pride which would disdain the help of any branch of knowledge. The chemist, with his hormones, organizers and other morphogenetic substances, must certainly be our constant companion. The physicist should more often be consulted, especially when he can speak with certainty of polarity, gradients, potential differences and fields of force in an organism. The mathematician, with his curves and coordinates, his beautifully precise methods of describing relationships and his remarkable science of topology, is evidently a friend to be closely cultivated. Since the climax of the integrative process seems to be the development of conscious personality, the student of organization should not fail to examine the findings of the psychologist, inexact and subjective as these often appear to an outsider; for, after all, the most intimate knowledge we can ever possess of any living organism is yielded through our unique point of vantage within one of them. Our problem may reach out so far that it transcends the more familiar categories of scientific thought so that ultimately we can not shirk the necessity of facing the problems of biological philosophy, and here the professional philosopher, especially if he has the advantage of understanding the results of modern biology, will be an indispensable guide. These all must be our allies. Let us never grow so pedantic that we shall frown on any brother who occasionally goes off the reservation of biological orthodoxy to refresh himself in other fields. He may well bring back from his excursion a treasure which those who stay at home can never find.

To all this, I am sure that most of you will readily agree; but you will point out that for years many of the best minds in biology have been devoted to just this problem; that the literature of Entwicklungsmechanik is enormous; that I am offering but a counsel of perfection in a field the difficulties of which I seriously underestimate, and that unless I have some constructive suggestions to offer, this would be a very appropriate time for me to sit down. I admit the validity of much of this indictment and hasten to offer here my own very slender contribution toward the solution of our problem. It is a development of two simple ideas, namely, that the process of biological organization takes place at various essentially independent levels and may be studied at any of them, and that one of these levels, the development of the multiple, determinate organ of the higher plants, provides exceptionally favorable material for such a study. These suggestions I propose to discuss briefly here.

Following the lead of the zoologists, we have been accustomed to look for developmental relations between the cell and the body as a whole. In plants, with their much looser organization, the problem is simpler than this, for there is clearly a level of organization between cell and body, the multiple organ, repeated indefinitely in a single individual and bearing somewhat the same unitary relation to the body as a whole that the cell bears to it. The nodes and internodes, leaves, flowers and fruits of the higher plants are examples of this sort of unit. The fruit, for various reasons, is especially favorable for study, and it is evidence from fruit development in the family Cucurbitaceae which I wish first to present.

That the fruit here is a distinct developmental entity, essentially independent of the cell below it and of the entire body above, is indicated by a number of facts. In any given race, the fruit has a very definite developmental history, both as to its size and form and as to its internal differentiation. This history is altered little or not at all by the size or character of growth of the plant as a whole. Environmental factors which markedly influence plant size have little or no effect on fruit size unless they are extremely unfavorable. Conditions which greatly increase total growth of the plant will increase the number of fruits it bears but not their size. The plant body is an indeterminate series of such multiple structures, their number depending on environmental factors but their particular characteristics being essentially autonomous.

Evidence is now available that the organ is equally independent of the next lower unit, the cell. If the growth of a cucurbit fruit from a tiny ovary primordium until several days after fertilization is measured, the rate of increase is found to be constant, there being a uniform daily percentage increment which is characteristic for a given race. Investigation shows that cell multiplication is occurring abundantly during the early part of this exponential growth period but then ceases, and that all subsequent growth results from cell expansion. The rate of growth, however, is exactly the same whether the cells are dividing or not. Furthermore, even while cell division is still going on, cell size is slowly increasing and the rate of division slowly decreasing. Thus the mass of material being poured into the young fruit is growing at a constant rate regardless of whether this mass is being cut up into new cells rapidly, slowly or not at all. Dry weight follows the same procedure, for it increases at a constant rate both before and after cell division ceases. Differentiation, too, proceeds independently of cell division, for the rate of division is found to be the same in all regions (axis, inner, middle and outer wall, and epidermis) but the relative proportions of these various regions change markedly along a gradient from the inside of the fruit outward. This evidence all suggests that the mechanisms controlling growth and differentiation in the fruit are concerned with the entire organ and not with the behavior and interrelationships of the individual cells of which it is composed. The unity of behavior, and thus presumably the unity of organization, inheres in the whole and not in its elements.

On its own level the cell also displays a unity of organization independent of the organ above or of smaller units below. Biologists have long recognized that cell size, for a given tissue, is relatively constant as compared with organ and body size. Every cell also seems to possess a uniform complement of genes.

These are not arranged at random but in a very definite order in each chromosome, and this constancy of position seems important in determining the rôle which a gene plays in development. Nor are the chromosomes entirely independent, for events in one have been shown to have effects on the others. The essential elements in the cell seem clearly to be the genes, for it is known that if one or at most a few of these are lacking, the cell will die. So far as can be determined the genes are of the same general order of magnitude and seem to be fundamentally similar units. It is in accord with the facts to regard the cell as an organized group of equivalent but somewhat differentiated genic units, just as we regard the organ as an organized group of equivalent but somewhat differentiated cells.

Of course one can speculate on the possibility that the gene itself is an organized aggregation, at a lower level, of still smaller units, perhaps protein molecules or simpler chemical entities, but our knowledge of genic constitution can go no further than to suggest that such may be the case. What is the ultimate living unit, if there is one, and of what it is composed are questions for the future to answer.

It should be noted that this process of organization is not a mere building up of similar units into an amorphous mass. Their arrangement and interrelations produce specific patterns which are evidently the result of a control more precise than one which would merely bring them together. Hence arises the problem of the development of organic form, which makes dynamic morphology a fundamental biological discipline.

The problem of organization thus presents itself as one which is concerned not with the entire organism alone but with a hierarchy of successively more advanced and essentially independent levels, from the gene or a still smaller unit to the body as a whole. It can be studied profitably at any level, for evidently the same process is at work in all of them, namely, the integration of a group of essentially similar units into a unity of a different and higher order with a specific pattern of its own. The primitive units of life, whatever they were—possibly something akin to genes or to virus particles—may have become organized into the systems which we now recognize as cells. Groups of cells remaining together in a multicellular mass may then have organized themselves into some higher entity, such as the metamere in animals or the multiple organ or perhaps the "phyton" in plants. From a series of these units is built up, in turn, the most complex entity of all, the body of the individual organism. In plants and many lower animals, like the annelids, this is still rather loosely organized and consists of an indeterminate number of essentially similar units. In most animals, however, integration is much more complete and the body has become a closely knit and highly differentiated entity. Throughout all these levels, the process is thus the same. So long as a mass of living material is continuous there is manifest in it this persistent urge to pull all parts together into a unity. Protoplasm seems inherently integrative in its activity, and only in certain tissue cultures and in clearly pathological conditions does this propensity for organization disappear. From this point of view, then, the cell is to be regarded not as a unique unit, but simply as one member of a series of units.

A recognition of the fact that organization is not a single event but proceeds from level to level is but a short step forward on a long and difficult path. How these units are pulled together and molded into a higher patterned synthesis is still beyond our knowledge. At least it is encouraging to know that the problem may be attacked at any level along the series and that we therefore possess the advantage so much esteemed by good generalship of being able to choose our battle-ground. The cell is too small for easy investigation, the whole body too complex. The multiple organs of the higher plants, however, offer ideal material for such studies. Of these organs the fruit is particularly favorable. It is large enough for easy investigation. Its form is relatively simple. It rarely becomes highly differentiated. Its structure is not closely involved with the function which it performs, as is that of the leaf. It has a relatively long developmental history. It is available in large numbers in the same individual, so that genetic identity is assured even under very diverse conditions. Developmental studies of such organs should yield much information as to the facts of growth and organization and should prove even more significant than have the more familiar studies on the early animal embryo. These structures, it seems to me, offer to botanists a notable opportunity for productive work on the problems of development.

In conclusion you will doubtless expect at least a word of concrete suggestion as to procedure. How can we lay hold of the elusive problem of organization, even with the best of material? The advice I have to offer will seem prosaic enough. It is to begin by describing with the utmost detail the phenomenon of organized development. Before the Darwin of morphogenesis can profitably indulge in synthesis, coordination and generalization, he must be provided with a far greater body of facts than are now available as to what actually happens in all stages of the developmental process. Our immediate task is to state as fully and exactly as possible, in terms of number, size, rate and position, just what occurs when an organized whole builds itself by multiplication of its parts. A vast amount of spade work of this careful but uninspiring sort must be done, tedious in execution but fruitful in results, in order to provide a basis of facts sufficiently rich and varied so that among them some thoughtful student may begin to perceive those significant relationships which will finally lead him into the heart of the problem.

Those early biologists who established the cell theory made the first great contribution to such a descriptive study of development, and under the stimulus of their idea, biological analysis has gained many triumphs in the century that is past. We can best honor these pioneers of yesterday, however, not by pushing indefinitely onward over the path they first began to blaze and which now seems destined to end blindly in discouragement and frustration, but rather to follow the pioneers of to-day along the far more difficult path which will lead, however distantly, to an understanding of biological syntheses. Life is integration. Life is the knitting together of units into patterned wholes. Many of the units we know, thanks to the labors of a hundred years. An understanding of how these units are built into the fabric of an organism is the task for the hundred years that are to come.

MATHEMATICIANS, AND POETRY AND DRAMA. II*

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I have referred to Hamilton as a youthful prodigy able successfully to compete with the American mental calculator, Zerah Colburn. But among many gifted mental calculators who gave public exhibitions of their prowess, no one could compare with Zacharias Dase, who was born at Hamburg in 1824 and died in 1861. He is known to have extracted the square root of a 100-figure number in 52 minutes, and to have multiplied two 100-figure numbers in 8¾ hours; there is reason to believe that this last-mentioned multiplication was no great tax upon his powers of mental arithmetic. Gauss, the greatest living mathematician of his time, got him to work on calculating mathematical tables of value, and as a result four important volumes were published. A few years before his death Dase published a volume of material about himself, extracted from his scrapbook.[53] In this material are 69 stanzas or poems in a variety of forms and by as many different authors. So far as I am aware this is the largest number of so-called poems on any single mathematician. But these measure rather the popular appeal of his peculiar gift.

No such acclaim awaited two men of superlative genius who died in their twenties about the time that Dase was born, but whose names are constantly mentioned wherever mathematical research is now carried on. The one was Evariste Galois, a Frenchman, killed in a duel when 21 years of age. The other, probably the greater genius, was Niels Henrik Abel[54] (1802-29), of whom Norway was later so proud. After the articulation of far-reaching mathematical discoveries and a gallant struggle with poverty, he died of tuberculosis at the age of 27, just as his achievements had brought high recognition, which would have filled his later life with ease and content and given him untrammeled opportunity to draw back curtains hiding eternal truths. At the centenary of his birth in 1902 a great international celebration was held in Oslo,[55] and a long French poem on "Abel" was read by Bjørnstjerne Bjørnson.[56] Happy indeed was the expression of thought in two lines of this poem:—

> Là où il a été
> on ne pense plus sans lui.

Several other poems about him include one engraved on his tomb. The centenary of Abel's death was internationally celebrated in 1929, and four Norwegian postage stamps bearing his portrait were then issued.[57]

Let us turn now to a British centenary. Nearly seven years ago throughout the English-speaking world there were elaborate celebrations of the centenary of the birth of Charles Lutwidge Dodgson[58] (1832–1898), familiarly known by the pen name Lewis Carroll, which he first used in connection with a poem he published shortly after he graduated from Oxford. No other mathematician in the writing of nonsense produced such an effect on his country's literature[59] or became so universally popular. His writings have been translated into Braille, Chinese, Czech, Danish, Dutch, Esperanto, French, German, Hebrew, Hungarian, Irish, Italian, Japanese, Latin, Norwegian, Polish, Portuguese, Russian, shorthand, Spanish and Swedish.

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* Concluded from the issue of SCIENCE for January 13.

[53] ''Zacharias Dase. Aufschlüsse und Proben seiner Leistungen als Rechenkünstler. Mitgetheilt von ihm selbst aus seinem Album,'' Berlin, 1856, vi + 122 pp.

[54] G. Mittag-Leffler, *Revue du Mois*, 4: 5–26, 207–229, 1907; E. T. Bell, ''Men of Mathematics,'' New York, 1937, pp. 307–326; G. Prasad, ''Some Great Mathematicians of the Nineteenth Century,'' Benares, v. 1, 1933, pp. 111–165.

[55] ''Niels Henrik Abel. Memorial publié à l'Occasion du Centenaire de sa Naissance,'' Christiania, 1902.

[56] See footnote 54.

[57] *Scripta Mathematica*, 1: 183, 1932.

[58] E. V. Lucas, ''Dict. Nat. Biog,'' Suppl., v. 2, 1901. W. De La Mare, ''Lewis Carroll,'' London, 1932; the best appreciation of Alice and her creator. S. H. Williams and F. Madan, ''A Handbook of the Literature of the Rev. C. L. Dodgson (Lewis Carroll),'' and Supplement, Oxford, 1931, 1935; invaluable work. F. Madan, ed., ''The Lewis Carroll Centenary in London, 1932, including a Catalogue of the Exhibition, with Notes,'' London, 1932. *Scripta Mathematica*, 1: 172–175, 349, 1932; 4: 318, 1936. ''Catalogue of an Exhibition at Columbia University to Commemorate the One Hundredth Anniversary of the Birth of Lewis Carroll,'' New York, 1932.

[59] F. J. H. Darton, ''Children's Books in England,'' Cambridge, England, 1932, pp. 268–269.

Dodgson was a mathematical lecturer at Oxford for more than twenty-five years, 1855-81, and he was ordained a deacon in 1861. Some of his more substantial mathematical publications are the following: "Syllabus of Plane Algebraical Geometry (1860); "Elementary Treatise on Determinants" (1867); "Euclid and his Modern Rivals" (1879; second ed. and *Supplement,* 1885), in dramatic form; "Curiosa Mathematica" (2 v., 1888–93, 4 eds.) of which the second volume was entitled "Pillow Problems thought out during Sleepless Nights"; "Symbolic Logic, Part I, Elementary" (1896, 4 eds.).

In 1933 his verse was collected in a volume of over four hundred pages. Most of the poems and songs are taken from such works as "Alice's Adventures in Wonderland," "Puzzles from Wonderland," "Through a Looking Glass," "Phantasmagoria," "The Hunting of the Snark," and "Sylvie and Bruno." Many of the songs have been set to music, and accompanying music has been written for a number of Lewis Carroll's writings which have been dramatized; more than sixty items might be mentioned in this connection.[60] There are also scores of parodies of Carroll's writings by others.[61] Much of the effect of many of his own poems was due to the fact that they were such admirable parodies of well-known poems of, for example, Hood, Longfellow, Scott, Southey, Swinburne, Tennyson, Watts and Wordsworth.

Poems about Carroll are doubtless fairly numerous. Among them are *Punch's* tribute by Owen Seaman,[62] and those by Austin Dobson,[63] E. V. Lucas[64] and Margaret Sangster.[65]

As Oxford and Cambridge are closely associated in our thought, it is but natural that next we should consider a Cambridge man. Not long ago a query was raised in the London *Times*[66] as to the authorship of a stanza

No power on earth, however great,
Can pull a string, however fine,
Into a horizontal line
That shall be absolutely straight.

A correspondent pointed out that it was to be found in the first edition (1819) of "An Elementary Treatise on Mechanics" by the prodigiously learned William Whewell[67] (1794–1866), who was second wrangler in 1816, master of Trinity, author of 'The History of Inductive Sciences," of "The Plurality of Worlds" and of many mathematical works. In the chapter on "The Equilibrium of Forces on a Point" the following "accidental stanza" occurred in the sentence: "Hence no force however great can stretch a cord however fine into an horizontal line which is accurately straight." In the form first quoted the original meter has been repaired. "Accurately" has been crowded out by a stronger word. It must have been the wags of Trinity College, Cambridge, who adorned the Whewellian muse. The matter was the subject of an editorial in the *New York Times.*[68]

But Whewell was the author of many real poems. One of the principal honors which he gained in his undergraduate career was the chancellor's medal for the best poem on Boadicea. When about 50 years of age he published a translation of Goethe's "Hermann und Dorothea," and various original poems in *Blackwood's Magazine.* But two volumes of his verse appeared in 1847, the first entitled, "Verse Translation from the German: Including Bürger's Lenore, Schiller's Song of the Bell and Other Poems"; and the second, "Sunday Thoughts and Other Verses." Eight years later, shortly after the death of his first wife, Whewell circulated some privately printed "Elegiacs," consisting of about 800 lines in 13 sections. In thanking Whewell for a copy, the poet Longfellow wrote: "I have read the poems with great interest and pleasure; and yet a painful sympathy with you in your affliction, which has found expression in such musical numbers. I am delighted to see the Elegiac metre introduced into English verse; it is so beautiful, and satisfies the ear so completely. And to you we must give the honor of its introduction, if we pass over the few specimens of translation from the German." When Whewell later wrote a review praising Longfellow's use of English hexameters in his "Evangeline," Longfellow was greatly pleased.

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[60] See Williams and Madan, *loc. cit.*, pp. 263–281; Supplement, pp. 18–20.

[61] See, for example, W. Hamilton, "Parodies of the works of English and American Authors," London, v. 4, 1887, pp. 55–59; C. Wells, "A Parody Anthology," New York, 1918, pp. 264–267; W. Jerrold and R. M. Leonard, "A Century of Parody and Imitation," Oxford, 1913, pp. 358–360; also, Williams and Madan, *loc. cit.*, pp. 287–309.

[62] Jan. 29, 1898; see Williams and Madan, *loc. cit.*, p. 346.

[63] Prefacing "Alice's Adventures in Wonderland," illustrated by A. Rackham, London, 1907; often reprinted.

[64] E. V. Lucas, "Another Book of Verses for Children," New York, 1925, pp. 377–378.

[65] *Good Housekeeping,* 94: 23, 1932.

[66] March 25, 1935.

[67] Leslie Stephen, "Dict. Nat. Biog.," v. 60, 1899. I. Todhunter, "William Whewell, D.D., Master of Trinity College, Cambridge," 2 v., London, 1876; "English Hexameters," pp. 283–301, "Poetical Pieces," pp. 367–375, 167. Mrs. S. Douglas, "The Life and Selections from the Correspondence of William Whewell," second ed., London, 1882, see especially pp. 87–88, 115–119, 243–244, 537–586. A. Macfarlane, "Lectures on Ten British Physicists of the Nineteenth Century," New York, 1919; "William Whewell," pp. 84–93.

[68] April 19, 1935; see also R. C. Archibald, *idem.*, April 23, 1935.

Whewell is also credited with the following verses:

U O a O, but I O thee,
O O no O, but O O me;
Then let not my O a O go,
But give O O I O thee so.

which is to be interpreted as:

You sigh for a cypher, but I sigh for thee,
O sigh for no cypher, but O sigh for me;
Then let not my sigh for a cypher go,
But give sigh for sigh, for I sigh for thee so.

One can imagine Wallie Hurwitz and Caesar Davis[69] exclaiming, *Whew—well* done!

The great variety of Whewell's studies struck some of his contemporaries as peculiar; for instance, Sidney Smith said of him: "That man's forte is science, and foible omniscience."

But almost a century before this Master of Trinity was appointed to a professorship at Cambridge, there died one who had been also a student and professor at Trinity, the greatest mathematical genius who has ever lived.

Newton died in March, 1727, and in June the future nature poet James Thomson (1700–1748) published his 209-line poem "Sacred to the memory of Sir Isaac Newton." It was issued as a folio volume dedicated to Sir Robert Walpole, then prime minister of Great Britain; four other editions were called for in the same year,[70] and two editions of an Italian translation were published in 1741 and 1760.[71]

Alexander Pope had a gift for the composition of epitaphs and often wrote them, or was called upon to revise those already written. His epitaph intended for Newton's tomb in Westminster Abbey, five lines in Latin and two in English, may be quoted[72] in this connection:

Isaac Newtonus:
Quem Immortalem
Testantur *Tempus, Natura, Coelum:*
Mortalem
Hoc marmor fatetur.
Nature and Nature's Laws lay hid in night:
God said, *Let Newton be!* and all was light.

This last fine epigram is often quoted. I was recently much surprised to discover that Aaron Hill, a contemporary of Pope, had not only written a poetic epitaph on Newton, but also the following epigram:

O'er nature's laws, God cast the veil of night,
Out blaz'd a Newton's *soul*—and *all* was *light.*

The great similarity of these lines to Pope's couplet suggests at once the question, Were they published before Pope's was in *The Grub Street Journal* for July 16, 1730? I found them in the first edition of Hill's "Works" published in 1753, four years after Hill, and nine years after Pope, had died. Hill's abilities as a poet and his relations to Pope hardly suggest that Pope was in any wise indebted to Hill.

As yet I have made no systematic effort to assemble *all* poems written about Newton[73] at the time of his death. The only other one with which I have met was that of another contemporary of Pope's, namely, Allan Ramsay (1685–1758), whose 14-verse "Ode on Sir Isaac Newton. Inscribed to the Royal Society of London for improving Natural Knowledge," recalls the fact that at the time of his death Newton had for 24 consecutive years been president of the Royal Society.

In more recent times we remember the "Watchers of the Sky" (1922) of Alfred Noyes, the first of his 3-volume work on "The Torch-Bearers." The fine forty-five page section on "Newton," not always conforming to the latest results of historical research, begins thus:

"If I saw farther, 'twas because I stood
On giant shoulders" wrote the king of thought,
Too proud of his great line to slight the toils
Of his forebears. He turned to their dim past
Their fading victories and their fond defeats,
And knelt as at an altar, drawing all
Their strengths into his own; and so went forth
With all their glory shining in his face;
To win new victories for the age to come.

And the concluding lines:

He rose at last so near
The Power divine that none can nearer go;
None in this age! To carry on his fire
We must await a mightier age to come.

It would seem as if Noyes must here have had in mind the closing lines of Edmond Halley's fine Latin ode on Newton prefixed to the first edition of Newton's "Principia.[74] In the translation of Professor Richardson, of the University of California, the concluding lines are as follows:

Then ye who now on heavenly nectar fare,
Come celebrate with me in song the name

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[69] That is, H. T. Davis, author of "The Fine Art of Punning" . . ., Colorado Springs, 1916.

[70] London, 3 eds., and Dublin, 1 ed.

[71] "Il Riccio Rapito [A. Pope] e le Lodi di Neuton [J. Thomson]. Poemi inglesi tradotti in Versi toscani dal Sig. A. Bonducci . . . con altri nuovi componimenti," Naples, 1760.

[72] "The Works of Alexander Pope." New ed. by Elwin and Courthope, London, v. 4, 1882, p. 390.

[73] J. W. N. Sullivan, "Isaac Newton, 1642–1727," London, 1938. E. T. Bell, "Men of Mathematics," New York, 1937, p. 90–116. L. T. More, "Isaac Newton, a Biography," New York, 1934. "David Gregory, Isaac Newton and their Circle," ed. by W. G. Hiscock, Oxford, 1937, "Sir Isaac Newton 1727–1927. A Bicentary Evaluation of His Work. A series of Papers prepared under the auspices of the History of Science Society," Baltimore, 1928. Mathematical Assoc., "Isaac Newton 1642–1727. A memorial Volume," London, 1927. *Scripta Mathematica*, 1: 179, 271; 2: 290–291; 3: 85, 185–186, 272; 4: 180–181. 1932–1936.

[74] Halley's Latin hexameters were printed in unmutilated form in only the first edition of Newton's "Prin-

Of Newton, to the Muses dear; for he
Unlocked the hidden treasuries of Truth;
So richly through his mind had Phoebus cast
The radiance of his own divinity.
Nearer the gods no mortal may approach.

It is this last line, "Nearer the gods no mortal may approach" which may be compared with that of Noyes:

He rose at last so near
The Power divine that none can nearer go.

There are many incidental references to Newton in the poets; I shall refer to only a few among English poets. Four are to be found in poems of Byron—one in his "Poem on Churchill's Grave" and three in stanzas of "Don Juan." The first stanza of canto X of the latter is as follows:

When Newton saw an apple fall, he found
  In that slight startle from his contemplation—
'Tis *said* (for I'll not answer above ground
  For any sage's creed or calculation)—
A mode of proving that the earth turned round
  In a most natural whirl, called "gravitation";
And this is the sole mortal who could grapple
  Since Adam—with a fall—or with an apple.

Towards the end of his life Newton is reported to have remarked: "I do not know what I may appear to the world; but to myself I seem to have been only like a boy, playing on the seashore, and diverting myself, in now and then finding a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me." This will explain the allusion in stanza 5 of canto VII of Don Juan:

Newton (that proverb of the mind), alas!
  Declared, with all his grand discoveries recent,
That he himself felt only like a youth
  Picking up shells by the great ocean—Truth.

One of Newton's great discoveries was that by means of a prism he could break up white light into its component colors. This prism is noted in Wordsworth's reference in the "Prelude," to Roubilliac's statue of Newton, the finest of all the statues in the chapel of Trinity College, Cambridge:

And from my pillow, looking forth by light
Of moon or favoring stars, I could behold
The ante chapel where the statue stood
Of Newton with his prism, and silent face,
The marble index of a mind for ever
Voyaging through seas of Thought, alone.

And finally, we may recall the passage in Southey's "Translation of a Greek Ode on Astronomy,"

There Priest of Nature! dost thou shine,
Newton! a King among the Kings divine.

Another great mathematical genius at Trinity College, who afterwards became a professor in the university, was James Clerk Maxwell[75] (1831–1879), whose work has had a profound influence on the progress and conceptions of physical science. It has, moreover, been instrumental in harnessing the ether for service of man and has thereby advanced civilization and increased the safety and happiness of mankind. He was another of the famous second wranglers, and wrote many papers of great value in the fields of pure and applied mathematics. It was early in his school career that he began to write verses, a practice which he kept up all his life, to the great delight of his friends. Many of these, including one famous in the domestic history of Trinity College, an ode "To the committee of the Cayley portrait fund" (1874), are given in Campbell's "Life" of Maxwell.[76]

We have referred to Whewell and Maxwell as second wranglers at Cambridge. Another who started his mathematical career as second wrangler, in 1837, became one of the most interesting and eminent of British mathematicians of the nineteenth century, James Joseph Sylvester,[77] who was born in 1814 and died in

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cipia,'' London, 1687. In the second edition (1713) Bentley omitted lines and touched up the Latinity in a number of places—not to its improvement, according to some scholars (*e.g.*, R. A. Sampson, *Nature*, 135: 129, 1935). In the third edition of the ''Principia'' Pemberton made but slight changes in Halley's original version. This is also to be found in ''Selecta Poemata Anglorum Latina,'' Bath, 1776, v. 3, p. 29. The three ''Principia'' versions were reprinted in: (a) S. P. Rigaud, ''Historical Essay on the First Publication of Newton's Principia,'' Oxford, 1838, p. 85–87; (b) D. Brewster, ''Memoirs of the Life, Writings and Discoveries of Sir Isaac Newton,'' Edinburgh, v. 1, 1855, pp. 457–459; (c) C. F. MacPike, ''Correspondence and Papers of Edmond Halley,'' Oxford, 1932, pp. 203–206. On pp. 207–208 of MacPike's work Halley's ode is given in English translation, by ''Eugeno,'' which Rigaud states, ''is not well done'' and which was originally published in Benjamin Martin's *General Magazine of Arts and Sciences, Miscellaneous Correspondence in Prose and Verse* for January, 1755, London, v. 1, 1759, p. 4. This was also reprinted in *Popular Astronomy*, 12: 504–506, 571, 1904. A new translation by L. J. Richardson is given in the Motte-Cajori edition of Newton's ''Principia,'' Berkeley, Calif., 1934; Sampson, *loc. cit.*, characterizes this as ''a poor affair and gives no evidence that the writer knew what he was talking about.'' The translation into Ido by G. H. Richardson, of Newcastle-upon-Tyne, England, was first published in *Kulturo, revuo por l'internaciona Kulturo per l'internaciona Linguo*, Budapest, 2: 29–31, January-February, 1924; reprinted in *Biblioteko dil Internaciona Kulturo*, 9, Budapest, 1924, and in G. H. Richardson, ''Spaco e Tempo,'' Newcastle-on-Tyne, 1929. It was also reprinted, with the Latin of 1687, in Richardson's ''Laudo di Newton da Halley,'' Newcastle-on-Tyne, 1925.

[75] For the general reader the following little volume would be especially interesting: ''James Clerk Maxwell. A commemoration Volume 1831–1931. Essays'' by J. J. Thompson, M. Planck, A. Einstein, J. Larmor, J. Jeans, W. Garnett, A. Fleming, O. Lodge, R. T. Glazebrook and H. Lamb, Cambridge, 1931. A. Macfarlane, ''Lectures on Ten British Physicists of the Nineteenth Century,'' New York, 1919, pp. 7–21.

[76] L. Campbell and W. Garnett, ''The Life of James Clerk Maxwell,'' London, 1882, pp. 577–651.

[77] A. Macfarlane, ''Lectures on Ten British Mathematicians of the Nineteenth Century,'' New York, 1916, pp.

1897. The father's name was Abraham Joseph, but his five sons—the eldest settled in New York—adopted the name Sylvester. James, the mathematician, was the youngest, and he has more than one connection with America; he was professor at the University of Virginia[78] in 1841–42 and the first professor of mathematics at the Johns Hopkins University from 1876 till 1883, when he was appointed Savilian professor of geometry at Oxford. Before the Johns Hopkins University opened its doors to students, the trustees of the institution were discussing with its president, Daniel Coit Gilman, the question of how to begin the work of the university which was to be a potent factor in higher learning in America. "Enlist a great mathematician and a distinguished Grecian," said the president, "your problem will be solved. Such men can teach in a dwelling house as well as in a palace . . . Other teachers will follow them." And thus were appointed the great Gildersleeve and the "soaring-geniused Sylvester," as Sidney Lanier characterized him.[79] Sylvester was the first editor, at Baltimore, of a great mathematical research journal, and he may be thought of as an inspiring source of modern American mathematics.

Throughout his life he gave evidence of thought teeming with poetical fancies. He had a keen relish for striking phrases, and many of his mathematical papers not only have original poetical introductions but are interspersed with poetical passages. Six years before coming to Baltimore he published a volume entitled "The Laws of Verse, or Principles of Versification Exemplified in Material Translations," and dedicated to his friend Matthew Arnold. The work contains many excellent translations from Horace and from German authors, as well as some original poems. He was accustomed to express his feelings in sonnets, and in his last years he composed considerable Latin verse. He wrote several "Studies in Monochrome," so called because they rang the changes upon a single rhyme through a long series of verses. Sylvester thought that these performances had an effect like that of "the regularly recurring dash and plash of the waves on the seashore." One such poem was "Rosalind," a "mock-sentimental" poem of four hundred lines, all ending in ĭnd or īnd. On several occasions Sylvester gave public readings from his poems. Lanier has given us an account of one performance at the Peabody Institute, Baltimore, in 1879 when his poem "Rosalind" was to be read.

> The audience quite filled the hall and expected to find much interest or amusement in listening to this unique experiment in verse. But Professor Sylvester had found it necessary to write a large number of explanatory footnotes, and he announced that in order not to interrupt the poem he would read the footnotes in a body first. Nearly every footnote suggested some additional extempore remark, and the reader was so interested in each one that he was not in the least aware of the flight of time or of the amusement of the audience. When he had dispatched the last of the notes, he looked at the clock, and was horrified to find that he had kept the audience an hour and a half before beginning to read the poem they had come to hear. The astonishment on his face was answered by a burst of goodhumored laughter from the audience, and then, after begging all his hearers to feel at perfect liberty to leave if they had engagements, he read the Rosalind poem.[80]

Since we have returned to America the voyage of observations draws to a close. Among those visited, who have been outstanding in poetry and drama? In this regard international acclaim has surely set on high the following men of mathematics: Omar Khayyám, Echegaray and Lewis Carroll, and the publications of Lewis Carroll, of which the poetry forms an important part, have been found to be the most universally popular. With reference to the mathematics of their times, Omar Khayyám was the leading mathematician of this trio.

What may be said concerning the literary productions of such geniuses and the future? In the case of Carroll the late E. V. Lucas, rare charmer of both children and adults, has made reply:

> "But will," the Prillil girl inquired,
>   "His writings ever die?
> Will people always love his books
>   The *same as you and I?*"
> "There is no doubt at all of that,"
>   The Grownup made reply.

107–121. E. T. Bell, "Men of Mathematics," New York, 1937, pp. 378–405. R. C. Archibald, "Unpublished letters of James Joseph Sylvester and other new information concerning his life and work," *Osiris*, 1: 85–154, 1936; "Sylvester's poetry," p. 102–112, containing a pretty complete bibliography.

[78] A portrait painted by G. Patten in 1841, just before Sylvester left England, was thrown on the screen during the lecture, and was thus made public for the first time.

[79] S. Lanier, "Ode to The Johns Hopkins University," read 22 February 1880, *Johns Hopkins University Circular*, 1: 88, April, 1880; also in "Poems of Sidney Lanier," edited by his wife, new edition, New York, 1922, p. 108. Lines 10–14 are as follows:

> From far the sages saw, from far they came
> And ministered to her,
> Led by the soaring-genius'd Sylvester
> That, earlier, loosed the knot great Newton tied,
> And flung the door of Fame's locked temple wide.

[80] This poem began as follows:

> In Cecilia's name I find
> (Deem not thou the guess unkind)—
> Celia, with a sigh combined,*
> Whose five letters, loose aligned,
> Magic, set and recombined,
> Fairest O! of lily kind,
> Shall disclose to every mind,
> From Far West to Orient Ind
> With each mortal thing unkinned
> Thy sweet name, dear Rosalind!

* Celia + ci = Cecilia.

OBITUARY

EDWARD MURRAY EAST

PERHAPS it is merely trite to say that the announcement of the sudden death of Dr. East came as a severe shock to all who knew him well. But how else can it be said? The abrupt cessation of a brilliant career—at an age which those of us, who in years were his seniors, must believe is little more than the prime of life—the sudden ending of such a career could not affect us other than with strong emotion. And yet who among us can say that East has not lived more in less than three score years than we may, if spared so long, in four score?

Edward Murray East, who died on November 9, 1938, was born on November 4, 1879, at DuQuoin, Ill., son of William Harvey and Sarah Granger (Woodruff) East. His preparatory schooling was at the DuQuoin high school. He was a student at the Case School of Applied Science in Cleveland in 1897–98 and at the University of Illinois in 1898–1905, where he received the degrees of B.S. in chemistry in 1900, M.S. in 1904 and Ph.D. in 1907. He was given the degree of LL.D. by Kenyon College in 1926.

He was married on September 2, 1903, to Mary Lawrence Boggs, of Washington, D. C., and had three children, Elizabeth Woodruff, Margaret Lawrence and Edward Murray (deceased).

He was assistant chemist, 1900–03, and first assistant in plant breeding from 1903 to 1905, at the University of Illinois Agricultural Experiment Station; agronomist at the Connecticut Agricultural Experiment Station from 1905 to 1909; assistant professor of experimental plant morphology from 1909 to 1914, and professor since 1914 at Harvard University. He was collaborator in tobacco investigations of the United States Department of Agriculture from 1908 to 1918; chairman of the botanical raw products committee and member of the botany and agriculture committee of the National Research Council in 1917–18; acting chief of the statistics division of the United States Food Administration in 1918. He was a member of the editorial board of *Genetics* since the beginning of that journal in 1916 and of the board of *Botanical Abstracts* from 1918 to 1922. He held the Harvard lectureship at Yale in 1924–25. He arranged the program of the Sixth International Congress of Genetics, held in Ithaca, N. Y., in 1932, and the success of this congress was due in no small measure to his efforts.

East was a member of numerous scientific societies: American Philosophical Society, American Society of Naturalists, of which he was president in 1918, American Genetic Association, National Academy of Sciences, New England Botanical Club, and others, and fellow of the American Academy of Arts and Sciences and of the American Association for the Advancement of Science.

A bibliography of East's scientific writings includes several books and over one hundred papers. Most of these papers present the results of his own researches in the field of genetics and its applications to plant breeding. His earliest papers, 1903–13, dealt in the main with the genetics and breeding of corn and potatoes. It was during this period that he rendered noteworthy service in the development of the method of corn breeding, crossing of inbred strains, which has revolutionized corn breeding throughout this country, a thoroughly worth-while practical method derived from theoretical genetic studies. During the latter part of this period, 1910–13, he more than any other geneticist showed the possibility of interpreting quantitative inheritance in Mendelian terms.

From about 1912 to 1929, numerous papers appeared on Nicotiana and particularly on self- and cross-sterility as exemplified in this genus. Although some, perhaps much, of this work was done by his students, his insight into this intricate problem was a guide throughout. The results of these combined and focused efforts will long stand as one of the brilliant genetic achievements of the period.

From about 1920 to the end, without abandoning his researches with plants, East turned to problems of more general interest. It was during this period that, undoubtedly as a result of judgment ripened through years of research and of wide reading, he turned more to the relations of genetics and of biology in general to human affairs. Even if, perchance, as some economists and sociologists have hinted, his economics was not wholly orthodox, it should not be overlooked that many writers have not even realized that biology has any place in discussions of human affairs.

It is not difficult to see how East's interests came to be wider than those of many geneticists. The brief outline of his student and professional career given above explains this at least in part. His early training in mathematics and physical science, particularly chemistry, progressing through agronomy and plant breeding to theoretical genetics and ultimately to more general biological problems, laid the foundation. This, coupled with wide reading, accurate observation, clear thinking and unusual clarity of expression, could not fail to give him a prominent place in the scientific developments of his generation.

R. A. EMERSON

SCIENTIFIC EVENTS

THE ACADEMY OF SCIENCES OF THE SOVIET UNION

A WIRELESS to *The New York Times* by Harold Denny, Moscow correspondent, states that preparations for the elections to the enlarged and "popularized" Academy of Sciences will take place at the end of January. It is said that there is every indication that membership will depend more than ever upon the candidate's practical value to Soviet economy and politics and upon his or her conformity to the Marxist ideology, as interpreted in Russia.

Mr. Denny writes in part as follows:

> It is likely, indeed, that this august body, the outgrowth of the academy founded by Peter the Great and which even in the beginning barred scientists who were politically or ideologically undesirable, will now include Alexey Stakhanoff, coal miner credited with initiating the speed-up system that is named for him, and other new heroes of Soviet life. . . .
>
> Stakhanoff and all four of the members of Ivan Papanin's North Pole ice floe expedition are among 800 nominees for the 150 vacancies among active and corresponding members to be elected. The Academy of Sciences now has eighty active and 230 corresponding members. By a recent decision of the government the number will be increased to 130 active and 330 corresponding members.
>
> For several days the Soviet press has been publishing nominations, together with articles praising or blaming the aspirants. Among the nominees praised to-day in *Pravda*, Communist party organ, are Alexey Tolstoy, famous author; T. D. Lysenko, known now as the "Soviet Burbank" for his development of new species of useful plants, who has often been in conflict with classical geneticists, and Andrey Y. Vishinsky, Commissar of Justice of the Soviet Union.
>
> Mr. Vishinsky is best known to the outside world as a prosecutor in treason cases, but he is the foremost authority on Soviet law, and his voluminous writings on that subject entitle him to consideration as a social scientist.
>
> Other candidates advanced to-day include Evgeni Chudakoff, proposed by the Stalin Military Academy of Motorization and Mechanization of the Red Army. He is credited in *Isvestia*, government organ, with creating harmonious scientific discipline upon which automobile building and engineering are based. Another is Valentin Kovalenkoff, who is acclaimed for his researches and inventions for improving telegraphic and wireless communication.
>
> Another is N. V. Tsitsin, one-time political commissar in the Red Guard during the civil war. He is now developing improved types of agricultural plants. According to *Pravda*, he is approved by Mr. Stalin, who told him: "Bold experimenter, we shall support you."
>
> On the other hand, *Pravda* has lent its authoritative columns to a long article signed by ten scientists, headed by Academian A. N. Back, biologist, opposing two candidates as "pseudo-scientists" who have no place in the academy. They are Professors L. S. Berg and N. K. Koltsoff, both biologists. They are accused of promulgating views more in keeping with Fascism than Marxism.
>
> Professor Berg, according to *Pravda*, published a book in 1922 entitled, "Monogenesis, or Evolution on the Basis of Conformity to Established Law," which evoked no praise here but was hailed by bourgeois biologists and translated into English. It is stigmatized to-day as an anti-Darwin treatise.
>
> Professor Koltsoff is denounced as a eugenist. Eugenics as a scheme for improving the human race is, in Soviet eyes, a reactionary and imperialist teaching directed against the toilers but adopted by Fascists as a basis for racial theories.

JEWISH PHYSICIANS IN GERMANY

THE Berlin correspondent of the *Journal* of the American Medical Association states that supplementary data can now be added to the recent reports appearing on the purge of Jewish physicians. On September 24 Professor Dr. Klare, "commissioner of the specialized medical press," issued the following statement:

> In view of the fact that the German medical profession is now freed of all members of an alien race, the writings of Jewish authors ought not to appear in our German medical journals. At the same time I trust that our German doctors will subscribe only to those foreign journals which are published by Aryan organizations and edited by Aryan physicians. In this connection I should like to call attention to the emigration of the journal *Ars Medici*, together with its Jewish editor and publisher, Dr. Max Ostermann, from Vienna to Switzerland. From its new home this publication continues to solicit the subscriptions of German doctors, but I feel sure that our men will refuse to have anything to do with the Jewish publisher of *Ars Medici*.

This periodical had circulated widely among practitioners within the German Reich. The correspondent continues:

> With respect to Jews in the insurance panel practice, it has been newly decreed that those Jews who have been allowed to continue in medical practice (under the restrictions described in previous letters) may now take part in panel practice among insured Jews and their families; a special permit is needed for panel practice.
>
> That, actually, a definite lack of physicians has resulted from the suppression, since October 1, of Jewish doctors is evidenced by the recent establishment of "policlinic treatment centers" at seventeen municipal clinics of Berlin. These centers are designed for the exclusive use of members of sickness insurance clubs and patients referred by the social service agencies; in other words, just those groups which are usually treated by the panel practitioners. It was expressly stated that these auxiliary centers were designed to lighten the load of the panel doc-

tors (a new consideration). The medical staffs of fourteen municipal emergency stations were also increased for the same purpose as well as for emergency house visit duty, especially at night. Meanwhile it has been decreed that the foregoing measures shall be discontinued on November 16.

When the question of obligatory practice in villages was taken up, the diet decided to take other measures to satisfy the demands for medical service and to raise the number of physicians. There are five universities with faculties of medicine, and the government proposed to establish a medical school in Lodz, a city of more than 500,000 inhabitants, which has had no university. The project was welcomed by the inhabitants of Lodz, and a committee was organized to supply financial aid for the founding of the school. The anti-Semitic organizations of students of medicine in other cities, however, passed a resolution protesting against the establishing of the school, claiming that it would increase the percentage of Jews in the medical profession, since there are many Jews in Lodz and the committee is supported financially by Jewish philanthropists. This action of the anti-Semitic students is held by democratic groups to be a handicap in the supplying of sufficient medical aid to the country. In spite of it the building of the new medical school will begin shortly.

THE COUNCIL FOR PEDIATRIC RESEARCH

THE Council for Pediatric Research is essentially a committee of the American Academy of Pediatrics, which has been in operation now for somewhat more than a year, supported for a trial period by a grant from the Carnegie Corporation. Its members are: Kenneth D. Blackfan, *chairman;* Thomas B. Cooley, *executive secretary;* Alexis F. Hartmann, Irvine McQuarrie, Oscar M. Schloss and Fritz B. Talbot. Offices are at 660 Frederick Street, Detroit.

The prime reason for the formation of the council lay in the notoriously unsatisfactory system of direct subsidization by manufacturers of investigation of their products by clinics and laboratories. Such investigations are usually prompted by a real desire to ascertain the value and uses of such products; sometimes merely for use in advertising. Studies primarily intended for advertising may, however, by proper handling give opportunity for really worth-while research. Some manufacturers are experienced enough to select competent investigators, others have wasted large amounts of money on ill-conceived, superficial, often obviously biased studies. At the best, direct subsidization is not very dignified and is open to suspicion of bias. It was believed that an impartial and authoritative committee might perform a real service by acting as intermediary between manufacturer and investigator, selecting qualified persons to carry out particular studies, suggesting or criticizing plans and finally, on publication, giving the study the stamp of its approval. It was planned that the council should charge a fee for such services, which eventually, in addition to covering its overhead, might build up a "free fund" to assist and stimulate needed research. Foundations and private philanthropists also might well dispense funds through the medium of the council.

Progress at first was slow. It was necessary to locate and gain the confidence of probable sources of grants for research, and at the same time to accumulate information as to capacities and interests of investigating clinics and laboratories. This groundwork has largely been done, and recently has shown results in the way of a number of projects which have been brought to the council for allocation to responsible clinics, and in several cases for assistance in planning a proper type of study. Another type of activity which it has recently undertaken is participation in a rather elaborate scheme for an intensive, long-term study of the various physical and mental phenomena of adolescence.

The council believes that as it becomes better known requests for its assistance will be multiplied, and its prime purpose of encouraging worth-while research furthered. It will welcome inquiries by any one interested.

THE ANNUAL REPORT OF THE SECRETARY OF THE SMITHSONIAN INSTITUTION

PROGRESS, especially in the design and construction of delicate instruments for astronomical and biological studies, and large additions to the scientific and historical collections were reported by Charles G. Abbot, secretary of the Smithsonian Institution, to the annual meeting of the Board of Regents.

The year was marked by progress in the building of the new National Gallery of Art presented to the nation by the late Andrew W. Mellon, and by the designation of a site and an appropriation for preliminary plans for a Smithsonian Gallery of Art.

Among the new instruments designed was an improvement of the galvanometer associated with the newest type of thermocouple. Dr. Abbot is confident that when the 200-inch telescope of the Carnegie Institution of Washington is available it will be possible with this instrument to get continuous spectrum energy curves of all types of stars.

A new observatory for solar radiation has been installed on Burro Mountain near Tyrone, N. M., to cooperate with the existing Smithsonian observatories in California and Chile to study solar variation and weather. Among plans for the future is one dealing with the measurement of variations of the sun's ultraviolet radiation in the upper atmosphere which can be determined by the amount of ionization of atmospheric atoms measured with an instrument attached to a sounding balloon. The greatest variation in the sun's total radiation comes in this ultra-violet band. Knowledge of it is expected to prove of value in weather prediction.

Dr. McAlister, of the Division of Radiation and Organisms, discovered a new phenomenon of photosynthesis—an uptake of carbon dioxide by leaves in darkness. This discovery was due to the development of a new instrument for measuring carbon dioxide assimilation—a subject hitherto practically beyond the possibility of investigation.

The addition of nearly a thousand animals was made to the collections of the National Zoological Park through an expedition to the East Indies led by Dr. William M. Mann, director of the park, and financed by the National Geographic Society. The collection included numerous species never before exhibited at the park.

The Bureau of American Ethnology, the branch of the Smithsonian Institution devoted to study of the primitive peoples of the New World, made progress in untangling the complex of Indian languages, especially the extensions of the Athabascan, the tongue spoken by the red men of northwestern Canada. This has an intimate connection with the problem of the peopling of the New World by migrants from Siberia. Archeological work was continued on the site in Colorado where Folsom man, the earliest known inhabitant of this continent, made weapons and tools used in hunting extinct animals that flourished during the closing days of the last ice age.

Important Arabic, Chinese and Persian manuscripts, paintings and art objects were added to the collection of the Freer Gallery of Art; and 312,729 specimens were added to the collections of the National Museum.

AWARD TO PROFESSOR WOOD OF THE RUMFORD MEDAL OF THE ROYAL SOCIETY

The Rumford Medal of the Royal Society, London, as already announced in Science, was awarded at the seventy-fifth anniversary meeting of the society on November 17 to Professor Robert Williams Wood, professor of experimental physics at the Johns Hopkins University. The medal has now been received in Baltimore by Dr. Wood, who was unable to attend the ceremony. It weighs fifteen ounces and is about three inches in diameter. On its surface is a profile of Count Rumford. With it was sent a silver replica of the medal.

Accompanying the medal was the following citation of Sir William Bragg, president of the society, which was read at the anniversary meeting:

> Professor Robert Williams Wood is awarded the Rumford Medal. The study of physical optics owes much to Professor Wood, who has been one of the leading experimenters in this field for the past 40 years. There is hardly a branch of the subject which he has not enriched by the touch of his genius.
>
> Before the advent of Bohr's quantum theory, when our knowledge of the structure of atoms and molecules was very meager, he had discovered the line and continuous absorption of sodium vapor, the phenomenon of resonance radiation of gases and vapors, and the quenching of this radiation by foreign gases. These discoveries opened up rich fields of research and were of the greatest value to later workers in laying the foundations of the theory of atomic and molecular spectra.
>
> The elucidation of the phenomenon of resonance radiation demanded the utmost experimental skill and resource. Nothing less powerful than an improvised 40-foot focus spectrograph sufficed for his work on the remarkable resonance spectra of molecules! Even now one can not but admire the beautiful and ingenious experiments on the independent excitation of the yellow sodium lines.
>
> In addition to his researches on the resonance radiation of metallic and other vapors, Wood investigated their magnetic rotation and dispersion. His work on the magneto-optics of sodium vapor both in the atomic and molecular state is now classical.
>
> More recent but belonging to the same domain of experiment are the very interesting discoveries of Wood and Ellett on the magneto-optics of resonance radiation.
>
> Wood's mastery of technique is universally acknowledged. He has introduced many ingenious and striking devices to experimental method. These are too numerous to catalogue here, but I would mention specially his method of the production of atomic hydrogen and his observations on the spontaneous incandescence of substances in atomic hydrogen which led to the invention of the atomic hydrogen welding torch by Langmuir; his very efficient and now widely used method of observing Raman Spectra; his échelette grating which has proved to be the grating *par excellence* for the investigation of the near and far infra-red, and his pioneer use of light filters in ultra-violet and infra-red photography.

SCIENTIFIC NOTES AND NEWS

On the occasion of the sixtieth birthday of Professor Howard T. Karsner, director of the Institute of Pathology and for twenty-five years professor of pathology at Western Reserve University, his associates and former pupils commemorated the event by presenting him with his portrait, painted by Rolf Stoll, head of the department of portraiture of the Cleveland School of Art. The event took place at a tea in honor of Professor and Mrs. Karsner on January 6, at the Institute of Pathology. Preceding the tea, the faculty of the School of Medicine gave a surprise luncheon at the Cleveland Club in honor of Professor Karsner.

The annual award of the Pittsburgh section of the American Chemical Society has been made to George Hubbard Clapp. The award, an aluminum plaque suitably inscribed, which will be presented at a meeting of the society on February 16, is made "in recognition of outstanding service to chemistry in the Pittsburgh District." Mr. Clapp, who recently celebrated his eightieth birthday, is a member of the Board of Directors of the Aluminum Company of America, president of the Board of Trustees of the University of Pittsburgh, a life member of the board of the Carnegie Institute of Technology and chairman of the Museum Committee.

The annual Lawrence Sperry Award given by the Institute of Aeronautical Science "to the young man making the greatest contribution to the advancement of aeronautics during the year" has been given to Russell Conwell Newhouse, of Orange, N. J., a member of the technical staff of the Bell Telephone Laboratories, New York City. The award is made for the development of the terrain clearance indicator, a device which indicates the altitude of an airplane over the terrain immediately below, whether it be water, land or buildings. The award with a check for $250 will be presented to Mr. Newhouse at the honors night dinner of the institute on January 27.

A Goethe Medal has been awarded to Dr. Eugen Korschelt, professor of zoology and comparative anatomy at the University at Marburg.

The Laura Leonard Prize of the German Society for the Study of Colloid Chemistry has been awarded to Professor M. Samec, of Ljubljana, Yugoslavia, for his work on the colloidal chemistry of starch.

Dr. Julian Park, dean of the College of Arts and Sciences of the University of Buffalo, has returned from France, where he received on December 3 the degree of *docteur honoris causa* from the University of Dijon.

Dr. Raymond Pearl, professor of biology in the School of Hygiene and Public Health at the Johns Hopkins University, was elected at the Detroit meeting president of the American Statistical Association.

The Berlin Society for Anthropology, Ethnology and Pre-history, of which Dr. Franz Boas, emeritus professor of anthropology at Columbia University, was a corresponding member, has discontinued his membership "on account of reliably reported hostility to present Germany."

At a meeting of the History of Science Society held in Chicago on December 29 and 30, the following officers were elected for the year 1939: *President*, Henry E. Sigerist, Baltimore; *Vice-presidents*, Richard H. Shryock, Philadelphia, and Louis C. Karpinski, Chicago; *Secretary-Treasurer*, Henry R. Viets, Boston; *Council*, F. R. Moulton, Washington; Hans Fischer, Zurich; C. L. G. Pratt, Oxford; Kenneth J. Franklin, Oxford; Erik Waller, Lidkoping, Sweden.

The Torrey Botanical Club held its annual meeting and banquet at the Faculty Club, Columbia University, on January 3. The following officers were elected: *President*, A. H. Graves; *First Vice-president*, G. T. Hastings; *Second Vice-president*, Miss Cornelia L. Carey; *Treasurer*, H. N. Moldenke; *Corresponding Secretary*, J. S. Karling; *Recording Secretary*, Miss C. Chandler; *Editor*, R. P. Wodehouse, and *Business Manager*, M. Levine.

Dr. William S. McEllroy has been elected dean of the School of Medicine of the University of Pittsburgh. He has been acting dean of the school since the death of Dean Raleigh Russell Huggins in February, 1938.

Dr. Harry W. Crane, professor of psychology at the University of North Carolina, has resigned as director of the Division of Mental Hygiene of the North Carolina State Board of Charities and Public Welfare, a position that he has held part-time since 1921, in order to accept the post, also part-time, of psychological consultant to the Health Center of the university.

Dr. Herbert B. Wilcox, professor of diseases of children at the College of Physicians and Surgeons of Columbia University, has been appointed director of the New York Academy of Medicine to succeed Dr. John A. Hartwell, who has resigned. The change will take place on April 1.

Dr. Errol Ivor White has been appointed deputy keeper in the Department of Geology of the British Museum (Natural History), and Frederick Allan Bannister has been appointed deputy keeper in the Department of Mineralogy. A. G. Gabriel, technical assistant in entomology, has been promoted to assistant keeper. William B. Fagg has been appointed assistant keeper in the Department of Ethnography.

Dr. Sylvanus Griswold Morley, of the Carnegie Institution of Washington, sailed on January 9 for Yucatan. This is his thirty-second annual visit. Members of the party include Frans Blom, director of the Middle American Research Institute of Tulane University, and Gerhard Kramer, associate in architecture.

Dr. Stanhope Bayne-Jones, dean of the School of Medicine of Yale University, recently spent a few days as guest of the faculty of the School of Tropical Medicine at San Juan, Puerto Rico. While in San Juan he gave a lecture on "Recent Advances in Cancer Research."

DR. BRONISLAW MALINOWSKI, professor of anthropology at the University of London, is spending the winter in Tucson, Arizona.

PROFESSOR O. A. BROWN, of the department of electrical engineering of the Iowa State College, has leave of absence to accept a position with the United States Government as associate electrical engineer. He will work at Washington on problems of agricultural engineering.

DR. HOSMER W. STONE, assistant professor of chemistry at the University of California at Los Angeles, has been invited to continue his research on oxidation reduction indicators at the University of Copenhagen. He plans to sail during the first week of February and to return to California in December.

PROFESSOR LAMERT S. CORBETT, dean of men and head of the department of animal industry at the University of Maine, has been granted for reasons of health leave of absence during the present half year.

DR. STACY R. METTIER, associate professor of medicine in the University of California Medical School, has six months leave of absence and has sailed for England, where he will study hematology and the leukemias, under the auspices of the Nuffield Foundation, with Professor L. J. Witts, head of the department of medicine at the University of Oxford.

THE Phi Sigma lecture was given on January 15 at Marquette University, Milwaukee, by the Rev. A. M. Schwitalla, professor of biology and dean of the Medical School at St. Louis University. His subject was: "The Importance of the Cell Theory and Its Application to Modern Biological and Medical Problems."

CLIFFORD C. GREGG, director of the Field Museum, Chicago, spoke at the ceremonies marking the opening of a new wing in the Museum of Science of the St. Paul Institute on December 1. His topic was: "The Place of the Local Museum in Its Community."

DR. JAMES BONNER, of the California Institute of Technology, recently addressed the Utah Chapter of Sigma Xi in Salt Lake City on "Recent Developments in the Study of Plant Growth."

DR. WALTER C. ALVAREZ, of the Mayo Foundation, delivered the third of the laity lectures of the New York Academy of Medicine on January 12. He spoke on "The Emergence of Modern Medicine from Ancient Folkways."

DR. WILLIAM H. HOBBS, professor emeritus of geology, University of Michigan, gave a lecture before the Lancaster Branch of the American Association for the Advancement of Science on January 19. The lecture, which gave an account of his three expeditions to Greenland, was entitled "Exploring about the North Pole of the Winds."

DR. EMMETT B. CARMICHAEL, professor of physiological chemistry, School of Medicine, University of Alabama, was the principal speaker on December 9 at the installation of the Mississippi Beta chapter of Alpha Epsilon Delta, national honorary premedical fraternity, at the University of Mississippi, and of the Mississippi Gamma chapter at Mississippi State College on December 10. Drs. W. F. Hand, Clay Lyle and J. W. Ward, of the college faculty, were initiated as honorary members of the Mississippi Gamma chapter. Dr. Ray J. Nichols, professor of biology, is faculty adviser of the chapter at the University of Mississippi.

THE two hundred and twenty-sixth regular meeting of the American Physical Society will be held in New York City on Thursday, Friday and Saturday, February 23, 24 and 25, 1939, as a joint meeting with the Optical Society of America and the Inter-Society Color Council. The sessions of the Inter-Society Color Council will be held on Thursday, February 23, at 480 Lexington Avenue, and those of the American Physical Society and the Optical Society of America on Friday and Saturday, February 24 and 25, will be held at Columbia University in the Pupin Physics Laboratories. A special symposium on television will be held probably on Saturday morning. Invited papers will be presented by V. K. Zworykin and Philo T. Farnsworth. It will be concluded with a demonstration of television reception which will be presented by A. F. Van Dyck. There will be a morning business session of the Color Council, an afternoon technical session on "color tolerance" sponsored jointly by the American Psychological Association, an evening popular session and a "Parade of Color," to consist of recent or interesting color developments in the fields covered by the various member bodies of the council.

THE spring meeting of the Electrochemical Society will be held at Columbus, Ohio, from April 26 to 29. Headquarters will be the Deshler-Wallick Hotel. Professor James R. Withrow, of the Ohio State University, is chairman of the local committee. The two main sessions of this meeting will be devoted to organic electrochemistry, under the chairmanship of Sherlock Swann, Jr., and refractories, under the direction of L. J. Trostel.

THE annual general meeting of the American Philosophical Society will be held on April 20, 21 and 22, beginning at 10 A. M. on Thursday, April 20.

THE sixth Australasian Medical Congress will meet in Perth, Western Australia, in August, 1940. The main theme of the congress will be "Rheumatic and Allied Disorders."

THE American Physical Society and the American Association of Physics Teachers held their annual meetings at the National Bureau of Standards in Washington on December 27 to 30. Over 400 persons registered for the meetings, including 315 from out of town. Seventy-nine papers were presented. The address of the retiring president, Dr. Lyman J. Briggs, on "The National Standards of Measurement," was followed by an inspection of these standards in the laboratories of the bureau. The joint dinner was attended by nearly 300 persons and was followed by a lecture by Dr. Harvey Fletcher on "Auditory Patterns," with experimental demonstrations. The next evening Professor P. W. Bridgman addressed the physics teachers on "Society and the Intelligent Physicist." The new officers of the American Physical Society are: John T. Tate, *president;* John Zeleny, *vice-president;* W. L. Severinghaus, *secretary,* and Geo. B. Pegram, *treasurer.*

THE National Advisory Cancer Council has recommended to the Surgeon General a grant of $11,900 to Cornell University Medical College, New York City, for work during a period of two years by Dr. Dean Burk, under the direction of Dr. Vincent du Vigneaud, professor of biochemistry, on cell metabolism fundamental to cancer, with the understanding that for the purposes of this study Dr. Dean Burk may be appointed a fellow in the National Cancer Institute.

THE Committee on Scientific Research of the American Medical Association invites applications for grants of money to aid in research on problems bearing more or less directly on clinical medicine. Preference is given to requests for moderate amounts to meet specific needs. For application forms and further information, apply to the committee at 535 North Dearborn Street, Chicago, Illinois.

DISCUSSION

BIOLOGICAL RESEARCH FILMS

IN view of the now considerable number of research films that have been produced in various widely distributed laboratories it appears highly desirable that these films be collected at some central point. Not only would such a collection serve to record, index and make available these valuable data, but also it should be useful to encourage and improve the quality of future research films.

It has been suggested that a cross-indexed and abstracted collection of such films relating generally to biological research be established at the Marine Biological Laboratory, Woods Hole, Mass. The plan, as outlined below, has received approval from the director of the laboratory and from the managing editor of the *Biological Bulletin,* providing a sufficient interest is expressed by biological investigators and others who have already made or who plan to use films in their research or teaching.

The collected suggestions of nine investigators who have produced films appear to crystallize around the following three interrelated points: (1) The establishment of a centrally located film library. (2) Appointment of an editorial board of film reviewers. (3) Publication of collected film abstracts in a recognized journal.

(1) The Marine Biological Laboratory as an independent institution, already equipped with an almost unequalled library and being visited by the most representative cross-section of biologists, seems a logical choice for location. As part of the library activities, one print together with a complete negative including titles should be submitted for cataloguing and permanent storage. At first, the author or his department might donate either the master negative or a copy, while the laboratory (if a source of funds can be found) could supply the positive.

(2) To assume responsibility for the plan's operation, it would be necessary for the trustees of the laboratory to appoint a board of review, consisting of three members. Its function would include passing upon the films submitted, rejecting those imperfectly titled, photographed or organized. In this manner the quality of films might be improved from year to year. Preference would be given those films of primary interest to workers in the Marine Biological Laboratory.

(3) To provide a running catalogue of the collection, a one-page abstract of each film accepted would be published annually in a winter issue of the *Biological Bulletin,* under separate heading, such as the *Biological Film Bulletin* or *Film Supplement.* Whenever desirable it is planned to print one or two frames from the film with each abstract. Copies of abstracts would be furnished to authors under the same conditions as hold for papers now published, and eventually the collected abstracts might be published in pamphlet form.

Even should the first years of operation of the above plan result in only few films being placed on record, it is nevertheless hoped that biological research will be substantially aided. It may become desirable to furnish at reasonable cost extra prints (approximately $15.00 per reel) to institutions and to individuals who request them. However this latter suggestion may considerably increase the sum of three hundred dollars now necessary to start the plan. For the present, rental of the films seems out of the question.

It is earnestly requested that all those interested in this plan will forward to the undersigned their own suggestions and criticisms, together with a definite statement as to the conditions under which they would be willing to submit both new and old negatives or prints to the Marine Biological Laboratory film collection. It would also be extremely helpful if any interested in obtaining extra prints from such a collection would communicate with us. Needless to say, furtherance of the plan will depend almost wholly upon the response from readers of this note.

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ROBERT CHAMBERS

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ANOTHER TREATMENT OF THE UNITS FOR F=ma

IN the October 14, 1938, issue of SCIENCE Professor Perkins says that there are only two essentially different ways of handling gravitational measures of force. I am not quite sure what Professor Perkins would call *essentially* different, but there is certainly another way which looks different and does not involve some of the difficulties which he discusses.

Let us use only $F = ma$. The quantities are all to be measured in units from Table 1 and for a particular problem must all come from the same horizontal row of the table.

TABLE 1

		Length	Time	Mass	Force	Energy
Absolute ...	Metric	cm	sec	gm	dyne	erg
	English	ft	sec	pound	poundal	ft poundal
Gravitational or Engineering	Metric	cm	sec	metric slug	gm-f	gm-f cm
	English	ft	sec	slug	pound-f	ft pound-f

The pound-f and gm-f are defined as the weight of a pound mass and gm mass respectively.

The slug and metric slug are defined as the masses to which a pound force and gram force respectively will give unit acceleration (1 ft/sec², 1 cm/sec²).

K.E. $\frac{1}{2}mv^2$, $F_c = mv^2/r$, Work $= Fs =$ change in potential energy.

We do not expect other formulas to be so written that we can enter them without first reducing the quantities involved to certain particular sets of units and still have the answer in terms of familiar units. We should do the same with $F = ma$.

With this treatment, only a single set of formulas is needed. Furthermore, no "g's" are scattered over these formulas like salt over a plate of food. In this country at present it is hardly possible to ignore "ft lb" of energy and horse power (=550 ft lb-f per sec). Hence, however much the physicists would like to forget gravitational units, they must continue to teach both systems, but that does not need to mean that there must be two sets of formulas.

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THE MOVEMENT OF WATER FROM CONCENTRATED TO DILUTE SOLUTIONS THROUGH LIQUID MEMBRANES

IN the experiment of W. J. V. Osterhout and J. W. Murray[1] recently commented on by H. E. Bent[2] it appears to us that the permeability of the membrane for the solvent as well as for the solute deserves special consideration.

If the membrane were permeable only for the solvent there would be a contradiction of the second law of thermodynamics. However, the fact that the solute is simultaneously transferable contributes a positive reduction in free energy which fully compensates the work required for the apparently anomalous movement of a certain amount of solvent.

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THE AMERICAN ASSOCIATION OF SCIENTIFIC WORKERS

IN a recent issue of SCIENCE (December 16, 1938) the announcement was made of the formation of a branch of the American Association of Scientific Workers in Boston and Cambridge, Mass. It is hoped to establish similar branches of this association in various centers as a means of bringing together scientists of different disciplines to study the problems of science and society and to endeavor to give effect to the natural desires of scientists as members of democratic society. Its program is in accord with publicly expressed opinions of prominent men of science, including leaders of the American Association for the Advancement of Science, and it is hoped that active groups of the American Association of Scientific Workers and individual members will be able to cooperate with the American Association for the Advancement of Science in its activities in the field of science and society.

Not long after the founding of the American Association of Scientific Workers the following letter was received from Sir F. Gowland Hopkins, president of the Association of Scientific Workers in Great Britain and a past president of the British Association for the Advancement of Science and of the Royal Society:

> I am much interested to learn of the foundation of the American Association of Scientific Workers, whose policy and program are so closely parallel to those of the Association of Scientific Workers in Great Britain.
>
> In these days when science plays so great a part in every field of modern life it is essential for scientific workers to organize, both to protect their own economic and professional status and to work for the better organization and application of science for the benefit of the com-

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[1] SCIENCE, 87: 430, 1938.
[2] SCIENCE, 88: 525, 1938.

munity. These problems are not confined to one country, and the Association of Scientific Workers welcomes the formation of a brother organization in America.

On behalf of the Association of Scientific Workers I would like to express the hope that you will receive great support from all scientific workers in America, and to wish you success in carrying out your policy.

At present the headquarters of the association is in Philadelphia, and we would be glad to receive inquiries from scientists in centers where there is not yet a local branch.

DONALD HORTON,
Corresponding Secretary

PHILADELPHIA, PA.

SCIENTIFIC BOOKS

CHARLES DARWIN

Charles Darwin. A Portrait. By GEOFFREY WEST. New Haven; Yale University Press. 1938. Pp. 359.

I TOOK up this volume with a feeling of prejudice; how could such an author, even after some years of diligent compilation, be in a position to appreciate Darwin's scientific work? Turning over some of the pages I found passages which confirmed my fears, and debated with myself whether to return the book to the editor unreviewed. Nevertheless, when I settled down to read the book page by page I had to admit that the recorded facts concerning Darwin had been collected with the utmost diligence, arranged with great care and set forth in a manner which made the book easy and profitable to read. With a reasonable amount of revision or expurgation, which I presume the author would not permit, the book might be described as a very satisfactory and illuminating biography. One can easily imagine the other side of the argument. It might well appear that after all a scientific worker who has grown up and lived in the Darwinian tradition was himself incapacitated for forming an impartial judgment. Morley, in writing the life of Gladstone, said that people would probably accuse him of partiality. He said that he would be sorry to be thought lacking in this quality; and one who is indebted to Darwin's influence in so many ways that it has formed a kind of atmosphere in which he has lived, cannot regard the matter with cold objectivity, or even wish to do so. It must be said of Mr. West, that throughout he regards his hero with respect and even affection, and shows little of the cheap cynicism with afflicts many biographers. He discusses the various personal and scientific matters, as they come up, with a lucidity which I fear few professional scientific workers could attain, and no one can read all this without profit. The available record as it stands probably does not do justice to the maturity of Darwin's mind when he sailed on the "Beagle." Having visited regions in South America which he described, I have been amazed at the accuracy and sagacity of his observations. I do not know who, to-day, could take such a comprehensive and understanding view of nature in a remote country visited for the first time. So again, his one important contribution to taxonomy, his monograph of the living and fossil barnacles, has stood the test of time as few such works have. This is the testimony of Pilsbry, the principal living authority on these animals. West's final chapter is headed "The Fragmentary Man," and he reaches the conclusion that "Darwin was incomplete and Darwinism accordingly inadequate as a philosophy by which men may live." I should put it differently. Darwinism is dynamic, and is not to be thought of as the basis of a static philosophy, nor does it pretend to deal with all aspects of reality. Since Darwin's time many important discoveries have been made, and were he living to-day, he would be the first to take account of them. The artist completes a work, and no one dares tamper with it; the scientific man, in contrast, is always on the road, never at the journey's end. In that sense all scientific work is fragmentary and incomplete, but this should not imply reproach. Considering his physical disabilities, and the limits of even the greatest human mind, Darwin was marvelous in his power of comprehending the larger aspects of nature, and the details of many matters. If he neglected subjects which we deem important we have no more right to complain than we should in the case of a noted pianist who did not play the flute.

The cry "back to Darwin" may have vitality to-day, as an encouragement to broader training and wider views, rather than the narrow specialization which is fostered by our educational methods. In this case, in spite of Mr. West's conception of Darwin as a "fragmentary man," I believe that his book will teach a different lesson, and may be read with profit as a stimulus to constructive thought and work.

T. D. A. COCKERELL

CONVERGENCE

A Text-book of Convergence. By W. L. FERRAR. Oxford University Press, 1938. viii + 192 pp. Price, $3.50.

As the title indicates, this book is a *text* on the theory of series. In the opinion of the reviewer it is clearly and carefully written, in a pleasant style, with good (albeit conventional) choice of material.

The subject-matter includes preliminary definitions of limit (especially well done), study of monotonic sequences, series of positive terms, comparison and ratio tests, alternating series, the Cauchy condition, uniform convergence, binomial and logarithmic expansions, integral tests, double series, Cesàro sums, Fourier series.

There are several unusual features of the book. (i) The now standard shorthand, such as:

$$\alpha_n \to 0 \textit{ if}$$
$$\varepsilon > 0;\ EN \cdot |\alpha_n| < \varepsilon \textit{ when } n \geqq N,$$

is introduced early, explained thoroughly and used consistently throughout the work. This is a great advantage in conciseness and clarity. (ii) The author divides all (real) series into three classes: convergent (when the sum S_n of the first n terms approaches a finite limit), divergent (when S_n becomes positively or negatively infinite), non-convergent (when S_n approaches no finite or definitely infinite limit). This classification is not commonly used, but is entirely appropriate. It is more discriminating than the usual classification, and notably more precise in such topics as power series and Abel's theorem. (iii) The book contains numerous well-graded and illuminating exercises. These are in part applications of the theory developed, in part elaborations of it; they alone are sufficient to justify the publication.

There are a few matters in which the reviewer fails to see eye to eye with the author. (i) The latter is not entirely consistent in his use of divergence, for he admits (p. 17) the notation $\alpha_n \to +\infty$, he asserts (p. 22) that if $S_n \to S$ then S is called the sum of the series, he later (p. 23, § 2.1) considers that a series has a sum if and only if S_n tends to a *finite* limit. (ii) More figures and better ones would be an aid to the beginner. For instance, the figures (pp. 84, 85) illustrating uniform convergence are not as closely related to the details of the definition as one might expect.[1] (iii) In proving (p. 84) the theorem on term-by-term integration in a finite interval of a uniformly convergent series, the author does not require continuity of the terms of the series, hence needs to *assume* the integrability of the sum of the series; he omits the remark that this condition is automatically fulfilled if the terms of the series are continuous. (iv) In the chapter on Fourier series, the author does not mention the least-square property of the partial sums; this omission is probably due to a desire to save space, but the property is an important one and can be established in a few lines. (v) The only general convergence theorem proved on Fourier series is that (granted integrability of the given function) of the series where convergent represents the average of the limits (assumed to exist) of the function approached from the right and left. This theorem is no shorter to prove and in the judgment of the reviewer much less interesting to the student (and to the physicist!) than the proof of convergence for functions say satisfying Dirichlet's condition, or even for functions that are piecewise smooth.

Despite these and other criticisms, the reviewer considers the book highly useful for undergraduates, especially when it is supplemented by lectures or tutorial instruction, and wishes it a wide-spread use in this country.

J. L. WALSH

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[1] Contrast, for instance, Osgood, Funktionentheorie I (Leipzig, 1928), pp. 97, 98.

SPECIAL ARTICLES

A METHOD OF EXTINGUISHING THE REFLECTION OF LIGHT FROM GLASS

H. D. TAYLOR discovered in 1892 that a tarnished photographic lens transmitted more light than a new lens. Since his discovery, several workers[1, 2, 3] have investigated means of treating glass surfaces so as to diminish the reflection and consequently increase the transmission of light by the glass.

Recent experiments have led to a method of coating glass with a film which extinguishes reflected monochromatic light. The film is made in such a way that the light reflected from the outer surface is equal in intensity and opposite in phase to the ray reflected from the glass-film surface. Under these conditions no light is reflected.

In order that a film shall have the property of extinguishing perpendicular light the film must fulfil the following two conditions:

(*a*) The substance of which the film is made must have a refractive index n_1, which has a value given by the equation

$$n_1 = n_0 n_g \qquad (1)$$

where n_g is the refractive index of the glass, and n_0 of the medium in which the glass is viewed which is commonly air.

(*b*) The film must have an optical thickness $n_1 t$, which is given by the equation

$$n_1 t = 0.25\ \lambda\ (2a + 1) \qquad (2)$$

where t is the thickness of the film and a is zero or an integer. A film having a thickness corresponding to the first order of interference, *i.e.*, a film for which $n_1 t = 0.25\ \lambda$, is far more effective in diminishing reflection when *white light* is used than films corresponding to minima of higher orders for which $a = 1, 2, \ldots$ etc.

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[1] F. Kollmorgen, *Trans. Soc. Illuminating Engineers*, 11: 220, 1916.

[2] Ordnance Department Document, No. 2037, p. 76.

[3] J. Strong, *Jour. Optical Soc. America*, 26: 73, 1936.

Built-up films of the soaps of fatty acids[4, 5] have provided a substance which can be treated in such a way as to have the value of refractive index which is required by Eq. (1) for the case of ordinary glass ($n_g = 1.52$) or for any glass of higher refractive index. The films are unfortunately soft and can be wiped from the glass with a cloth. However, they provide an extraordinarily useful tool for studying the application of the phenomena of interference to problems of light reflection.

The substance of which a built-up film is commonly composed is a mixture of a fatty acid and of the soap of a fatty acid. Thus the composition of Y-films of so-called "barium stearate" is about 50 to 80 per cent. barium stearate, and the remainder is stearic acid. When films of this substance are soaked in a solvent for stearic acid, the film is left as a skeleton of barium stearate, with air filling the spaces previously occupied by the stearic acid.

If a film has initially a refractive index $n_1 = 1.50$, and if 50 per cent. of the material is removed without causing the film to shrink in thickness, the refractive index of the skeleton is 1.232. This is the value of n_1, which serves to extinguish the reflection of light from glass $n_g = 1.518$; that is, from glass of the type of ordinary window glass.

Skeleton films can be built of cadmium arachidate, which are better in optical quality than those built of barium stearate. The films are built by spreading arachidic acid in a monolayer on the surface of a bath which is 10^{-4} M cadmium chloride, 10^{-3} M sodium acetate, 1.2×10^{-4} M HCl, pH 5.7. They are built to the desired thickness on both sides of a plate of glass by the ordinary methods used in making built-up films. The thickness of a film having 42 or 44 layers of skeletonized cadmium arachidate is a quarter wave-length of sodium light. The built-up film is soaked for about 2 minutes in alcohol, and then in acetone at 35° C–40° C until the refractive index has decreased to the extinction value.

A film built in this way completely extinguishes the reflection of sodium light, and nearly extinguishes all visible light of other wave-lengths. When a plate of ordinary glass is placed a few inches from a 6,000-lumen sodium vapor lamp, with a black background behind the plate, the glass reflects a bright glare of yellow light, whereas if the glass is coated with a non-reflecting film the coated area appears as black as black velvet. A stripe of this type of film, built on a plate of glass, increases the transmission of light from 92 per cent. for clean glass to 99.2 per cent. for the film-coated glass. When one looks through the glass at the sky or at a sheet of white paper, the stripe has the appearance of clean glass, and the clean glass on either side of the stripe appears to be slightly smoked.

The difference in reflection is particularly striking in the case of the type of glare which prevents an observer from seeing objects which are behind a glass window. For example, one half of the glass cover of an instrument meter was coated with a non-reflecting film, and the contrast between the coated half and the uncoated half was so striking that observers seeing this instrument for the first time were deceived by the illusion that there was no glass on the film-coated half.

A paper describing the full details of this work will be published in the near future.

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CITY AIR SEARCHED FOR SULFUR FUMES

RESULTS of a 15-month survey to determine the *average* amounts of sulfur gases in the air of American cities, long a subject of speculation and dispute, are announced by Air Hygiene Foundation and Mellon Institute. The average amounts of sulfur fumes found in 25 cities studied were comparatively small.

More than 50,000 separate air tests were made by six chemists driving a fleet of cars equipped like "traveling laboratories." They canvassed industrial and residential centers throughout the East, South and Midwest, from August, 1936, to October, 1937. Most of the tests, covering all hours of day and night and all seasons of the year, were made in five metropolitan districts. The five, in the order of their sulfur dioxide pollution, are given in Table 1 (figures indicate parts of sulfur dioxide per million parts of air).

TABLE 1

City	Within 15-mile radius of center of city	
	Average	Maximum
St. Louis—East St. Louis ...	.128	2.266
Pittsburgh	.057	.897
Detroit	.028	.396
Philadelphia—Camden	.027	.424
Washington	.009	.290

The above figures are of no significance from a public health standpoint, according to hygienists connected with the investigation. That is, "in the concentrations found, the contaminants do not exert harmful physiological effects."

The survey showed that the home fires are among the large contributors to sulfur pollution, particularly in districts using coal of high sulfur content. The type of coal burned in a locality was mirrored in the

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[4] K. B. Blodgett, *Jour. Am. Chem. Soc.*, 57: 1007, 1935.

[5] K. B. Blodgett and I. Langmuir, *Phys. Rev.*, 51: 964, 1937.

results of the study. The fuel factor also explains why sulfur pollution in most districts was approximately 50 per cent. higher in the "heating season" than in the summer months. Some industrial operations also discharge sulfur fumes, unless properly safeguarded.

A close relationship was found between wind velocity and the amount of sulfur dioxide in the air. The higher the wind the cleaner the air. Fogs catch and "store up" the sulfur fumes. Some of the highest concentrations were noted on foggy nights.

Occasional tests were made in a score of other cities. Dr. H. B. Meller, managing director of Air Hygiene Foundation, cautioned that results obtained in these cities can not be compared with the findings for St. Louis, Pittsburgh, Detroit, Philadelphia-Camden and Washington. He pointed out that "only a few tests were made in this group, not enough to arrive at a typical, average figure, as in the case of the five centers which formed the backbone of the survey." Results for the 20 other cities are given in Table 2.

TABLE 2

City	Summer average	Winter average
Baltimore	.021	.081
Chicago	.067	.091
Cleveland	.064	.081
Wheeling	.070	...
Nashville	.028	.093
Cincinnati	.021	.064
Buffalo	...	.044
Youngstown	.049	.026
Louisville	.022	.041
Ft. Wayne	.028	...
Richmond	.009	.047
Indianapolis	.023	...
Toledo	.023	...
Chattanooga	.011	.035
Springfield, Ill.	.021	...
Birmingham	.017	.017
Charlotte, N. C.	.015	...
Johnstown	.014	...
Harrisburg	.011	...
Atlanta	.012	.032

J. D. Alley directed the field work and compilation of data. Dr. J. L. Sherrick was in charge of the chemical laboratory. Both were fellows on the Air Hygiene Foundation Fellowship at Mellon Institute. Six chemists were employed in the field. One operated a "rover" laboratory, visiting a score of cities. The others were stationed in the five metropolitan districts described.

Each of the five field men traveled a prearranged route, covering about 130 designated stations in each of the five districts. The stations were scattered through business districts, parks, industrial sections and residential neighborhoods, and ranged from the center of a city to 25 or 30 miles in the suburbs. This was done to determine the *average concentration* rather than temporary "peaks" and "lows."

The field chemists worked a "staggered" schedule, 8 A.M. to 4 P.M., one week, 4 P.M. to midnight the next, etc. Their day off was also rotated. Thus over a period of 15 months they obtained comprehensive checks on sulfur concentrations for each hour of the 24, each day of the week and each season of the year.

JOHN F. MCMAHON

THE NATURE OF THE CARBOHYDRATE IN THE GONADOTROPIC SUBSTANCE OF PREGNANCY URINE

THE presence of carbohydrate in gonadotropic hormone preparations from pregnancy urine has been observed by numerous investigators. Fischer and Ertel[1] have stated that the properties of their relatively crude material agreed closely with urinary mucoid and ovomucoid, while Meyer,[2] working with highly active preparations, also characterized the hormone as a mucoid. Hartmann and Benz[3] have very recently reported studies of the carbohydrate of their APL hormone preparations, but were unable to decide whether their material contained mannose, galactose or a mixture of both. They published no details regarding the purity of their product.

By a process which will shortly be published in detail, hormone preparations have been made assaying 1,000 to 3,000 units per milligram by the Friedman rabbit assay method. These fractions contain carbohydrate, hexosamine and acetyl groups[4] as previously found by Meyer[2] in his preparations. Pentose, ketohexose and uronic acid were shown to be absent.

Our early determinations[4] of reducing sugar by the Hagedorn-Jensen procedure gave values that were too high as a result of errors produced by the accompanying products of protein hydrolysis. Clarification with $Zn(OH)_2$ did not materially lower the figures. Similar errors have been observed by Mundy and Seibert[5] as well as Hewitt.[6] The Shaffer-Hartmann method, however, yields lower results.

Using suitable methods we have obtained evidence to indicate that our purest preparations contain 2 hexose groups for each hexosamine. Assuming that the carbohydrate in the hormone is composed of trisaccharide units containing 1 hexosamine and 2 aldohexose groups, we have compared two of our best preparations with the commonly occurring aldohexoses by means of the carbazole[7] and orcinol reactions.[8]

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[1] F. G. Fischer and L. Ertel, *Zeit. physiol. Chem.*, 202: 83, 1931.

[2] K. Meyer in R. Kurzrock, "Endocrines in Obstetrics and Gynecology," p. 116. Williams and Wilkins, 1937.

[3] M. Hartmann and F. Benz, *Nature*, 142: 115, 1938.

[4] S. Gurin, C. Bachman and D. Wright Wilson, *Jour. Biol. Chem.*, 123: proc. xlix, 1938.

[5] B. Munday and F. B. Seibert, *Jour. Biol. Chem.*, 100: 277, 1933.

[6] L. F. Hewitt, *Biochem. Jour.*, 32: 1554, 1938.

[7] Z. Dische, *Mikrochemie*, 8: 4, 1930.

[8] J. Tillmans and K. Philippi, *Biochem. Zeit.*, 215: 36, 1929.

The color produced by the hormone preparation in the carbazole reaction was compared with those yielded by glucose, mannose, galactose and equimolar mixtures of all the pairs of these sugars. Determinations of the relative transmission of light in the spectral regions 420, 520, 540 and 660 mμ were made by means of an Evelyn photoelectric photometer. The characteristic ratios of extinction coefficients at two wave-lengths (*e.g.*, 420 and 520 mμ) for glucose, mannose, glucose-galactose and galactose-mannose were found to be different from that given by our hormone preparations, while galactose and a glucose-mannose mixture could not be distinguished from the hormone by this method.

To differentiate between our hormone preparation and galactose or a glucose-mannose mixture the orcinol method as modified by Sörensen and Haugaard[9] was utilized. Solutions of the hormone preparation, galactose and the glucose-mannose mixture (each in 3 different dilutions) were heated 20 minutes at 80–81° with the orcinol reagent and the colors compared at 420 and 520 mμ. The ratios of the extinction coefficients for our preparations and the glucose-mannose mixture were different, while those for the hormone preparation and galactose were similar.

As both the orcinol and carbazole methods gave ratios of extinction coefficients for our hormone preparations which agreed well with those obtained for galactose, we conclude that the nonhexosamine sugar of our gonadotropic hormone preparations consists entirely of galactose units. Obviously final proof of the nature of the carbohydrate must await its isolation and characterization. *It must be further emphasized that* the presence of several galactose units along with a single different hexose molecule would be extremely difficult to detect by the methods we have employed. However, we consider this possibility to be unlikely.

Further details of the above study will be published shortly.

We wish to thank the American Philosophical Society and the National Research Council for financial assistance.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

INTRAVENOUS INFUSION PUMP[1]

FOR intravenous infusion in animals, it is desirable to have an automatic device which is simple, is easily adjusted to deliver various amounts and has a high degree of accuracy. The following apparatus seems to meet these requirements and is designed and used for the digitalis cat-assay. It consists essentially of a stopcock, turned by a constant speed motor, which in one position connects a pipette with a reservoir from which it is filled and in the other position connects the pipette with the vein into which it empties (see Fig. 1). The filling level (F) of the pipette is determined by the position of the reservoir. The emptying level (E) is determined by the position of a device which makes it independent of venous pressure variations, and which has been used in a perfusion method for isolated organs with constant volumes of fluid[2]: The venous canula is connected with the lower end of a vertical glass tube (25 cm length, 0.4 cm inside diameter), which has a short T arm sealed close to its open top. One opening of the stopcock is connected with this T arm, and the fluid (from the pipette) enters the glass tube, runs down along the walls of the tube, at the lower end of which it is collected as a fluid column which flows into the vein. (A wool thread in the glass tube, stretching

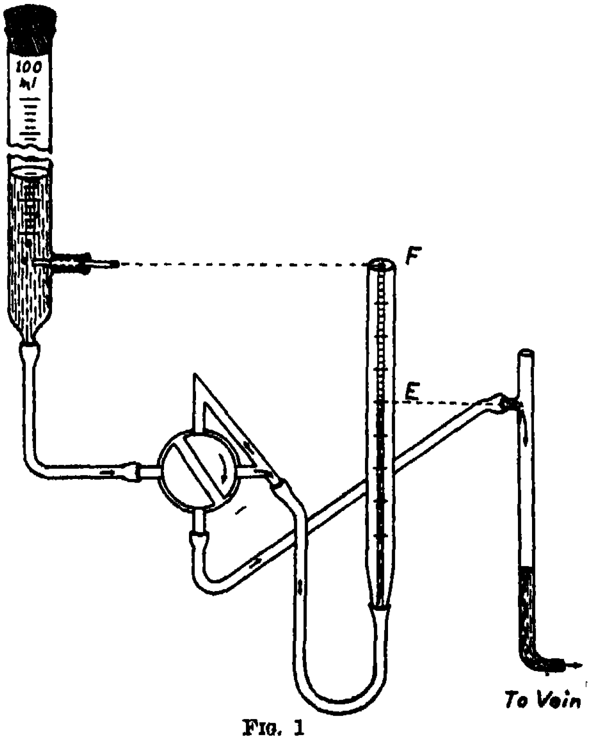

FIG. 1

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[9] M. Sörensen and G. Haugaard, *Biochem. Zeit.*, 260: 247, 1933.

[1] Aided by a grant from the David Trautman Schwartz Research Fund and a grant to Dr. Erwin E. Nelson from the United States Pharmacopoeia XI Revision Committee.

[2] G. Katz, *Arch. Intern. Pharmacodyn. et Therap.*, 44: 1934, 239.

from the top to the bottom, helps to guide the fluid down and prevents it from clogging the narrow tube and enclosing air bubbles.) By completely exposing the vein to a length of 2–5 cm and using a canula with a fairly narrow opening, blood is prevented from entering the canula. The height of the fluid column is determined by venous pressure and canula resistance and obviously does not influence the inflow from the pipette into the open tube. Incidentally, since it follows venous pressure changes, it might be used to indicate a sharp endpoint in the digitalis assay; the ceasing of the heart action, by increasing the venous pressure, suddenly raises the fluid level; this is followed by a drop, representing the complete arrest of the heart.

The reservoir, which is a burette used as Mariotte-bottle and thus delivers under nearly constant pressure, and the pipette are clamped to one stand, which by means of a rack and pinion can be raised or lowered. The pipette is shortened by cutting it off at the zero level, where it is ground with emery. Its height is adjusted so that it is completely filled from the reservoir without overflowing, the surface tension provided by the dry, ground top preventing the fluid from leaving the lumen even when the air-inlet tube of the reservoir is somewhat above the zero level of the pipette. This preparation of the pipette eliminates a slightly inaccurate filling which would otherwise occasionally occur from the inflow disturbance caused by the air bubbles entering the Mariotte-burette. The venous inflow tube is clamped to a second stand, at a height determined by the position of the animal. The position of reservoir and pipette above the entrance point of the fluid into the inflow tube determines the emptying level of the pipette, which is easily adjusted by turning the pinion, with the motor running. The level to which the pipette empties represents the amount of fluid per "stroke" which, together with the number of revolutions of the stopcock, determines the amount infused per minute. (A revolution counter, driven by the stopcock, allows of calculating the total amount infused at any given time more accurately than can be done by reading the burette level.) The synchronous motor (Telechron, C2M) has one r.p.m. of the shaft, which, by means of two gears, drives the stopcock at 3 r.p.m.; this makes for 6 infusions per minute, which are more or less leveled out in the glass tube. The accuracy of the pump depends solely on the accuracy of the pipette. For our purposes, a "Kahn pipette" (0.2 ml, calibrated in 0.001 ml) is being used.

GERHARD KATZ
TULANE UNIVERSITY SCHOOL OF MEDICINE

AN EASY METHOD FOR MAKING AN INDEX

RECENTLY confronted again with the odious task of preparing an index for a book of more than a hundred pages, I sought for an easier method than writing the entries on twenty-six sheets lettered A to Z and then alphabetizing each sheet. I also wanted a less expensive and time-absorbing technique than using a separate filing card for each entry. The plan hit upon worked very well. Sheets of typewritter paper were fed into the typewriter. On each with double spacing were typed the needed entries, starting each entry on a new line:

Light for photosynthesis	95
Photosynthesis, light for	95
Transpired water	96
Water, transpired	96

With a photographic trimmer, the lines were later chopped apart and sorted into piles A to Z. A roll of Scotch tape was then partly unrolled, placed on the opposite side of the work table with the unwound part toward me, adhesive face up. The Z slips were arranged alphabetically and pressed to the nearer end of the tape, starting with the last of the group. Next the Y slips, and so on. The tape was later cut between slips at about eleven-inch intervals and made satisfactory copy for typing out the complete index, starting at Aa, the last slip fastened in place.

LORUS J. MILNE
RANDOLPH MACON WOMAN'S COLLEGE

BOOKS RECEIVED

Australasian Antarctic Expedition, 1911–14, Scientific Reports, Series C, Zoology and Botany; Vol. I, Part 3, Parasitic Infusoria from Macquarie Island, by T. Harvey Johnston. Pp. 12. 26 figures. 2/6–; *Vol. II, Part 4, Amphipoda Gammaridea*, by G. E. Nicholls. Pp. 145. 67 figures. 17/6–; *Part 8, Pycnogonida*, by Isabella Gordon. Pp. 40. 8 figures. 5/6–. Paisley, Sydney, Australia.

DIEBNER, KURT and EBERHARD GRASSMANN. *Kunstliche Radioaktivität, Experimentelle Ergebnisse.* Pp. 87. S. Hirzel, Leipzig. 12.—.

JONES, INIGO. *The Climate of Australia during the Hypothetical Jovian Sunspot Cycle, 1913–1924, together with the Monthly and Annual Rainfall Observations.* Ninth Paper of the Crohamhurst Observatory. Pp. 111. The Observatory, Brisbane.

SMALL, LYNDON F. and others. *Studies on Drug Addiction with Special Reference to Chemical Structure of Opium Derivatives and Allied Synthetic Substances and their Physiological Action;* Supplement No. 138, *Public Health Reports.* Pp. viii + 143. Illustrated. Superintendent of Documents, Washington. $0.60.

STEWART, OSCAR M. *Physics; A Textbook for Colleges.* Third edition. Pp. x + 750. 500 figures. Ginn. $4.00.

SWIFT, ERNEST H. *A System of Chemical Analysis (Qualitative and Semi-Quantitative) for the Common Elements.* Pp. xx + 589. 32 figures. Prentice-Hall. $6.00.

TRAUB, HAMILTON P., Editor. *Herbertia, Volume 5.* Pp. 218. 2 figures. 34 plates. American Amaryllis Society, Orlando, Florida.

VOKES, HAROLD E. *Molluscan Faunas of the Domengine and Arroyo Hondo Formations of the California Eocene;* Vol. XXXVIII of the *Annals* of the New York Academy of Sciences. January 4, 1939. Pp. iii + 246. The Academy.

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EARTH STRUCTURE AND EARTH ORIGIN[1]

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In his book "The Solar System and Its Origin,"[2] Henry Norris Russell presents a critique of the several theories of earth origin, which may fairly be taken as representative of the attitude of most astronomers toward this problem, responsibility for the solution of which they share with geologists. Full consideration is given to the planetesimal hypothesis of Chamberlin and Moulton and to the modifications of that hypothesis which have been proposed by Jeffreys and Jeans. The obstacles which forbid whole-hearted acceptance of any one of these hypotheses are forcefully presented. The conclusion is frankly stated "that no one can yet say how our system originated in detail."

It is nevertheless apparent that the most hopeful line of research leads toward some hypothesis of origin during an encounter between the sun and another heavenly body. In other words, the fundamental principle of the planetesimal hypothesis is accepted. Future investigators are most likely to work toward the discovery of the particular modification of that hypothesis which will best fit the facts now known or to be ascertained.

Commenting specifically upon the planetesimal and tidal theories, Professor Russell states: "It is here that the two theories part company—the planetesimal supposing that the existing planets were formed mainly by the slow agglomeration of small cold bodies, and the tidal that they were all once liquid and have picked up much less matter in later times. This difference, while very important to the geologist, is really rather small from the standpoint of the astronomer."[3]

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[1] Address of the vice-president and chairman of Section E, American Association for the Advancement of Science, Richmond meeting, December 28, 1938.

[2] New York, 1935.

[3] *Loc. cit.*, p. 102.

Geologists, as such, are deeply concerned with the problem of earth origin primarily because they want to know whether the earth was essentially molten at some time in the past, after it had attained the state of a separate planetary body possessing approximately its present mass, or whether it was an essentially solid and relatively small planetary body to which has been added a considerable fraction of its present mass by some process of accretion. Upon the answer to that question depend some of the most fundamental ideas concerning diastrophism and vulcanism. No satisfactory theory concerning the processes of mountain-making, the origin of igneous rocks, the mechanism of volcanic eruptions or the dynamics of isostasy can be formulated without a commitment concerning that phase of the juvenile history of the earth.

Apparently, the geologist can not expect the astronomer to tell him the answer which he thus needs to learn. He must secure it for himself by investigating the structure of the earth's interior and by reasoning backward from observed geological phenomena to the antecedent conditions which alone can explain all the intricate details of the present structure of the earth's exterior.

That the earth has grown by the addition of extraterrestrial matter is of course a conclusion based on direct observation. Reliable estimates of the number and average weight of meteorites which have reached the earth during the last few years indicate that the daily accretion of meteoric dust is of the order of magnitude of 50,000 tons.[4] This would mean that the earth's mass is increasing at a rate of approximately 20,000,000 tons per year. At that rate the earth would have acquired 2×10^{16} tons of previously extra-terrestrial matter in a billion years and twice that amount, or 4×10^{16} tons, in the two billion years which seem to have elapsed since its birth. That stupendous mass is, however, only one one-hundred-and-twenty-five thousandths of the present mass of the earth, roughly 5×10^{21} tons. If one half or two thirds of the earth's body has been built up through planetesimal accretion, the rate of infall must have formerly been a hundred thousand times as great as it is to-day. This is of course explicitly accepted in the planetesimal hypothesis, but it throws the whole question back into the realm of speculative deduction. On the other hand, we may note that 4×10^{16} tons of matter with an average density of 3.0 would form a layer only a little more than 100 feet thick around the earth.

That fact probably has no real significance, but it at least serves to direct our attention at this point to the problem of the physical condition and chemical composition of the earth's interior. Geophysical research has yielded much important data during the last two decades, and ideas concerning the fundamental structure of the earth are now taking definite and trustworthy form.

The records of earthquakes indicate unmistakably that the earth has a stratiform structure. Its body is composed of several successive shells which differ from each other in elasticity, as indicated by the travel-times of the seismic vibrations. The central core of the earth, approximately 2,200 miles in radius, is notably different from the surrounding shells in its physical properties. The several shells and the earth core are separated from each other by surfaces or transition zones appropriately known to the seismologist as discontinuities. Most of the discontinuities are marked by a fairly abrupt change in the velocity of propagation of the seismic vibrations and hence are known as discontinuities of the first order. Some are marked by a variation in the rate of change in velocity with increased depth and hence are known as discontinuities of the second order.

The statements in the preceding paragraph would probably be accepted as valid by all competent investigators in this field and may therefore be used as basic data upon which any useful concept of earth structure must be constructed. They present in general terms the specifications which must be met by any satisfactory theory of earth origin. It is indeed the demonstration of the stratiform structure of the earth which more than anything else has caused many geologists to become skeptical of the adequacy of the planetesimal theory of earth origin and to look with favor upon a theory in which the juvenile earth is conceived to have been essentially a liquid globe at the time it possessed approximately its present mass.

There yet remain a multitude of unanswered questions concerning the earth shells and the earth core. Divergent interpretations of the same data have been made by several competent investigators. Essential data concerning the response to stress of earth materials under conditions of great pressure and high temperature are still lacking, and at present the deficiency can be met only by untrustworthy extrapolation or debatable assumption. The available information concerning travel-times, refractions and reflections of seismic vibrations is inadequate for the incontrovertible appraisal of the several working hypotheses and must be amplified by the study of records secured in the future at existing seismograph stations or at stations which should be established to complete the necessary network of such stations the world around. It should nevertheless prove helpful to review the present state of knowledge and inference, with special consideration of its bearing upon the problem of earth origin.

It would appear that no doubt can now remain con-

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[4] *Cf.* H. H. Nininger, "Our Stone-Pelted Planet," p. 91. Boston, 1933.

cerning the crystalline nature of earth materials down to a depth of at least 60 kilometers. Above that depth, within continental segments, there seem to be at least three shells which differ from each other in their responses to stress. The outer shell beneath the surficial and discontinuous veneer of sedimentary or metamorphic rock is granitic in composition, the next is an intermediate zone which may be composed largely of diabasic or gabbroic rocks, and the third consists of materials which behave as either pyroxenite or dunite would probably behave at such depths.[5] The last-mentioned shell constitutes the "crystalline sima," as that term is used by Daly,[6] who, however, considers its composition to be more like that of gabbro than of peridotite. It is believed to be continuous beneath the oceans the world around. Readily recognized discontinuities of the first order separate these shells from each other. Thicknesses of the shells and hence depths to the discontinuities vary considerably from place to place. Most of the figures cited by those who have generalized upon the matter are average figures rather than specific ones.

The determination of the depth of a discontinuity depends at present upon the selection of certain assumptions from several which appear almost equally reasonable concerning the propagation of vibrations in the earth's interior as well as the choice of the particular measurement of wave velocities which shall be applied. Consequently, different investigators working with the same data have reached different conclusions, and diverse data secured at various localities have yielded notably different results. This, however, does not in the least invalidate the general principle that discontinuities are present and that the earth is composed of successive shells with unlike properties.

As expected, the limits within which our present knowledge confines the selection of data are much narrower for the shallow than for the greater depths. Laboratory conditions can be established which closely imitate the conditions of pressure and temperature existing at depths approximating 25 kilometers and of pressure at depths of at least twice that figure. Field studies involving the use of artificially generated vibrations include the accurate determination of travel-times for impulses originated by dynamite blasts transmitted for distances as great as 175 miles. Thus the depth of the discontinuity at the inner surface of the granitic shell beneath southern New England is rather definitely fixed as 14.5 kilometers.[7] Data from other localities, as interpreted by various geophysicists, indicate depths between 10 and 25 kilometers.

The intermediate zone is computed variously to have a thickness of 15 to 40 kilometers. The depth to the discontinuity at its inner surface is between 25 and 60 kilometers; Daly uses 40 kilometers as an average determination. Sharpe[8] computes its average depth beneath 17 widely scattered stations as 32 kilometers. Differences in the determinations are almost certainly due to actual variations in the thickness of the two outer earth-shells from place to place and not entirely to differences in interpretation of data.

The depth to which the crystalline sima extends is still a question for speculative consideration. The next clear-cut discontinuity of the first order, below the bottom of the intermediate zone, which has been generally recognized, is at a depth of approximately 475 kilometers. There are, however, some significant data concerning shadow-zones and wave amplitudes which have been interpreted by Gutenberg[9] as suggesting the presence of material having a slightly lower velocity beneath the high-speed crystalline sima at a depth of 60 or 70 kilometers. Daly computes[10] that the temperature below 60 kilometers is such that the sima must be in a vitreous rather than a crystalline state. This would of course explain the apparent retardation of the wave of dilatation at a depth of 60 or 70 kilometers and would thus be in keeping with the seismological specifications.

Temperatures and pressures at depths between 60 and 400 to 500 kilometers are such as to put rock materials very close to the boundary between the vitreous and crystalline states. It requires only a rather steep, but still perfectly plausible, temperature gradient to yield the computations upon which Daly bases his concept of a vitreous substratum. A slightly lower temperature gradient, offset by the increase in pressure, would permit the crystalline state to persist to greater depths; the precise temperature gradient, density distribution and chemical composition selected would determine the depth at which a vitreous rather than crystalline state would be found. Under reasonable assumptions it seems almost certain that beyond a depth of a few hundred kilometers, because of the great pressures there prevailing, the earth materials, if lithic rather than dominantly metallic, must be crystalline. As pointed out by Daly,[11] "the vitreous basaltic shell (must) be relatively thin, perhaps nowhere more than a few scores of kilometers in thickness." Possibly the 475 ± kilometer discontinuity marks the change from vitreous to crystalline materials rather than merely the increase in the intrinsic density required to meet the specifications necessary to give the earth its known moment of inertia.

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[5] Francis Birch and Dennison Bancroft, *Jour. Geol.*, 46: 59–87, 113–141, 1938.

[6] R. A. Daly, "Architecture of the Earth," pp. 51–59. New York, 1938.

[7] L. D. Leet, *Bull. Seismol. Soc. America*, 28: 45–48, 1938.

[8] J. A. Sharpe, *Bull. Seismol. Soc. America*, 25: 199–222, 1935.

[9] B. Gutenberg, Grundlagen der Erdbebenkunde, Berlin, 1927. See also Daly, *loc. cit.*, pp. 67–69.

[10] *Loc. cit.*, p. 62.

[11] *Loc. cit.*, p. 69.

The unanswered question concerning the physical state of the material in this relatively thin substratum may never be resolved by seismic research. Birch and Bancroft[12] report that "the velocities in crystalline and vitreous gabbroic materials tend to become equal as the temperature increases." If this tendency actually establishes equivalent velocities, the question becomes meaningless so far as seismology is concerned.

There is, however, another question of great importance to both geologist and cosmogonist, although significant for different reasons when considered from one or other of these two view-points. That is the question of the intrinsic strength of the materials in this quasi-vitreous substratum. This is the zone, or a part of the zone, to which Barrell long ago applied the apt term, asthenosphere. Much evidence has accumulated to strengthen the geologist's belief in the correctness of the essentials of Barrell's concept. Only on the assumption that the substratum is unable to withstand any appreciable accumulation of long-continuing stress can one explain many of the observations concerning isostatic adjustment, as for example those pertaining to the phenomena of loading and unloading the earth's crust during a glacial episode. Daly[13] has recently emphasized anew the extreme weakness of the asthenosphere. Using data from Hirvonen and Witting, he finds that the maximum strength at a depth of 100 kilometers is less than 2.5 kilograms per square centimeter. This computation should be compared with Barrell's estimate of 200 to 300 kilograms per square centimeter and with Jeffreys' calculation of 100 kilograms per square centimeter.

Probing still deeper into the earth's inaccessible interior, we find that seismologists have recognized several discontinuities between 475 ± kilometers and 2,900 kilometers. The position of these discontinuities is, however, subject to almost constant revision as new data are obtained or old data are reinterpreted. At least one of them, located somewhere near 1,000 kilometers beneath the surface, is a discontinuity of the second order and it may prove at last that all of them are actually in this category, marking a change in the rate of increase of velocities rather than an abrupt change in the velocities themselves. Certainly there can be at present no confidence in the precision of any of the announced locations of supposed discontinuities of the first order in this subterranean region. Such discontinuities may exist, but if they do their position can not now be determined with anything like the accuracy which pertains to those at shallow depths beneath the continents.

On the other hand, it appears quite certain from a consideration of the requirements imposed by the earth's known moment of rotational inertia that the changes in density with depth in this zone are due to differences in the chemical composition of the materials, not merely to increased compaction of like materials under increased load. These requirements are best satisfied if we postulate the presence of a shell of rock material having the chemical composition of dunite or peridotite beneath the quasi-vitreous substratum. Toward the inner surface of this shell there must be increasing quantities of material "chemically like the iron-bearing stony meteorites"[14] and below a depth which may be in the neighborhood of 1,000 kilometers the earth shell must be essentially of that type of substance.

At approximately 2,900 kilometers there is a well-recognized discontinuity of the first order. Below that depth, earthquake waves encounter material giving much lower velocities than those which characterize their transmission in the immediately superjacent zone. This explains the well-known "shadow zone" between 105 and 142 degrees from the epicenter of world-shaking earthquakes.[15] This discontinuity marks the effective surface of the earth's core, frequently designated the "iron core," because a composition of iron and nickel in approximately the same ratio as those metals display in the iron meteorites would probably give the required velocities for longitudinal vibrations (waves of dilatation) under reasonable assumptions for temperature and pressure.

Thus far, no unchallengeable identification of a seismogram phase as due to a wave which passed through the earth's core as a shear wave (transverse vibration) has been announced. Such waves can not be transmitted through liquids, but it is probably misleading to say that it is therefore known that the iron core is a liquid core. To call it a quasi-liquid core would give a more accurate impression. There is at present no knowledge concerning the behavior of any metallic solid under the conditions of temperature and pressure which must maintain at great depth within the earth. The molecules of iron and nickel may be associated in the earth's core in ways that transcend all human experience with solids, liquids or vapors.

Turning then from conjectures that could hardly be profitable, we note the bearing which the concept of a stratiform earth may have upon the theories of earth origin. Any earth model capable of satisfying the requirements of modern knowledge concerning the physical properties of the earth's interior must inevitably present a challenge to the planetesimal theory. To provide a stratiform earth by specific gravity settling is a relatively simple proposition for a molten-earth theory such as the tidal theory of Jeffreys and Jeans, but it is not immediately apparent that an earth built in large part by planetesimal accretion would attain that structural configuration. Accepting this challenge, T. C. Chamberlin in his later presentations of the planetesimal theory[16] rejected the enticing detour which would involve the liquefaction of the planet after its growth by accretion had been practically completed. "There does not seem to be any cogent reason for assuming that molten planets would arise from this mode of aggregation, except in those cases in which the knots were very large."[17] He proposed instead that the stratiform structure arose in part from the selective nature of the processes of accretion and in part from selective vulcanism, both of which would tend to segregate the denser and more metallic or less silicic substances toward the center, and the less dense and more silicic substances toward the periphery of the juvenile earth. Chiefly because of skepticism concerning the quantitative effectiveness of these selective processes, Chamberlin's attempt to explain the stratiform structure within the framework of the planetesimal theory has never met with wide-spread approval.

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[12] Francis Birch and Dennison Bancroft, *Jour. Geol.*, 46: 141, 1938.

[13] R. A. Daly, *Trans. Am. Geophys. Union*, 19th Ann. Meeting, pp. 35–39, 1938.

[14] *Cf.* Daly, *loc. cit.*, p. 69.

[15] *Cf.* L. D. Leet, "Practical Seismology and Seismic Prospecting," pp. 161–168. New York, 1938.

In view, however, of our present knowledge of the behavior of crystalline and vitreous solids under conditions of great pressure and high temperature, it would appear that this stumbling-block has been removed. The intrinsic strength with which such solids resist deforming stress is astonishingly slight. Convection must occur in an asthenosphere as weak as the quasi-vitreous substratum appears to be, if there are appropriately located differences in density due either to variations in chemical composition or to changes in temperature. Ideomolecular reorganization of crystals is stimulated in crystalline solids under the conditions which prevail throughout the earth's interior beneath a thin surficial zone. It is indeed quite impossible to prevent the earth, regardless of initial heterogeneity of materials, from developing a stratiform arrangement of those materials according to density, as slow adjustment takes place within its body during its long history.

Thus an earth originally heterogeneous and always essentially crystalline would eventually be organized into its present structural form with a central core of intrinsically dense materials surrounded by concentric shells of progressively less dense substances. At all times it would react as an elastic solid to the sudden impacts or abrupt release of energy which initiate earthquake vibrations, but at all times it would be subject to "solid flow," which would tend inevitably toward specific gravity assortment. If this is true, the existing structure of the earth's interior could be explained with equal effectiveness regardless of its origin, whether by planetesimal growth or by condensation from a gaseous "filament." This would mean that the geologist would be unable to use the earth's fundamental structure as a criterion for appraising the relative merits of the planetesimal and the tidal hypotheses.

There is, however, another consideration which may put him in a better position to pass judgment in this particular court of appeal. Somewhere in his cosmogony he must find a place for the forces which have produced the folded structures in the earth's outermost shell and the fundamental differences between the continental and oceanic segments. The former involve the horizontal compression of certain portions of the lithosphere; the latter involve the segregation of granitic materials in the continental protuberances. Here there is an essential difference between the two theories of earth origin.

Several alternative theories of mountain-making diastrophism are worthy of attention. These include horizontal shifting of earth-blocks as a result of convection currents in the substratum, or of de leveling, or of forces resulting from the earth's rotation as a planet with which a large satellite is associated. These avenues of investigation should be pursued, but at the moment none of them appear particularly promising. Volume changes due to local alterations in temperature seem wholly inadequate to explain the known crustal shortening. The oldest theory of all, circumferential shortening of a radially shrinking earth, appears to be still the most favorable lead. The effects of earth condensation would produce structures such as we find in every great chain of mountains; the efficiency of the process is unquestioned. The problem is to explain earth-shrinkage itself.

All investigators agree that the rate at which the earth loses its body heat is altogether too small to account for more than a trivial fraction of the shrinkage necessary to explain the amount of circumferential shortening revealed by post-Cretaceous mountain-making compression. We may say quite dogmatically that the cooling of the earth is not an adequate cause of the known horizontal compression of the lithosphere. There remains the possibility that physical and chemical reorganization of the materials composing the earth's interior has been such as to increase sufficiently their average density and thus produce the required decrease in volume for the earth as a whole. Chamberlin long ago appealed to this process in seeking an explanation for the diastrophism which produces folded and overthrust mountains. The argument is still valid. It applies, however, only to an earth constructed according to the planetesimal program; it is utterly ineffective in an earth which has solidified from a molten state. If at last we find no escape from the idea of a shrinking earth, we must render our verdict in favor of the planetesimal theory rather than the tidal.

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[16] T. C. Chamberlin, "The Origin of the Earth," Chicago, 1916, and "The Two Solar Families," Chicago, 1928.

[17] T. C. Chamberlin, *loc. cit.*, 1916, p. 147.

The second basis for testing the theories of earth origin is found in the attempt to explain the segmentation of the lithosphere into continents and ocean basins. Here the problem is to account for the segregation of less dense, granitic materials beneath the protuberances and the denser, gabbroic material beneath the basins. Chamberlin's explanation was in terms of selective in-gathering of planetesimal debris under the influence of atmospheric circulation, combined with selective placement of the products of weathering by the agents of transportation and deposition. Under the tidal theory, the segmentation of the granitic shell, originally continuous the world around, must be accomplished during the rupture accompanying the birth of the moon. Both ideas must be critically reviewed in the light of any new knowledge which may be secured in the coming years. Neither can be whole-heartedly accepted or bluntly rejected at the present moment. The line of departure between the two is so clearly defined and leads to such far-reaching consequences that there is good reason to expect a definite verdict in the near future. The bearing of that verdict upon the theories of earth origin is obvious.

In summary, it would appear that the concept of earth structure based on recent geophysical and seismological research is not nearly so unfavorable to acceptance of the planetesimal theory of earth origin as many geologists have supposed it to be. On the contrary, in at least one particular—that which deals with the origin of folded mountains—modern investigations pertaining to the fundamental structures of the earth have brought renewed confidence in the basic principles of that theory.

OBITUARY

EDWIN HERBERT HALL

PROFESSOR EDWIN HERBERT HALL, universally known to physicists as the discoverer of the Hall effect, died on November 20, 1938, at the age of 83 years. He was born in Gorham, Maine, on November 7, 1855, fitted for college in Gorham Seminary, entered Bowdoin at 15, and graduated with the A.B. degree at the head of his class at 19. During 1875–76 he taught as principal at Gould's Academy in Bethel, Maine, and during 1876–77 was principal of the Brunswick High School. In 1877 he entered the Johns Hopkins University as a graduate student of physics, and from 1878 to 1880 was fellow in physics, working under Rowland and receiving the Ph.D. degree in 1880. He continued on as assistant in physics during 1880–81, when he was appointed to a Tyndall scholarship for study and travel abroad. During the summer he made measurements on the "Hall" effect in Helmholtz's laboratory in Berlin, and read a paper reporting these measurements at the York meeting of the British Association in the summer of the same year. He returned to this country in the fall of the same year to an instructorship in physics at Harvard, a position which he held until 1888. From 1888 to 1895 he was assistant professor at the same institution, professor from 1895 to 1914, Rumford professor from 1914 to 1921, and professor emeritus from 1921 till his death. He was a member of the A.A.A.S. (vice-president of the section of physics in 1904), of the American Physical Society, the American Academy of Arts and Sciences, the National Academy of Sciences, corresponding member of the British Association for the Advancement of Science and foreign member of the Société Hollandaise des Sciences. He received the LL.D. degree from Bowdoin in 1905, was a member of the Solvay Congress at Brussels in 1924 and of the Volta Congress in Como in 1927, and in 1937 received the award and medal of the American Association of Physics Teachers for notable contributions to the teaching of physics, and was made the first honorary member of the association.

Professor Hall's great contribution to the teaching of elementary physics was a pioneering contribution, made at a time when physical laboratories were almost unheard of in this country. In 1886 he published, with the encouragement of President Eliot, the well-known "Harvard Descriptive List of Elementary Physical Experiments." These had the unique merit of demanding apparatus simple enough so that it could in many cases be constructed by the teachers themselves without undue strain on their meagre budgets. This "list" was followed by several elementary text-books, the best known perhaps being "A Textbook of Physics" by Hall and Bergen in 1891. It would not be unfair to describe Professor Hall's work as entirely remolding the scheme of secondary school physics, and as such exerting a most important influence, but since this matter is freshly in mind through the articles in the *American Physics Teacher* for February, 1938, at the time of the award, it is not necessary to elaborate further here.

Of course Professor Hall will always be best known for the Hall effect, discovered while working for his

Ph.D. degree with Rowland in 1879. This effect is usually described as a difference of potential transverse to the lines of current flow, which appears when a magnetic field is applied perpendicular to the current. It had been vaguely predicted by Kelvin in 1851, expected and vainly searched for by a number of experimenters, including Rowland himself, independently expected by Professor Hall and found only after a couple of unsuccessful attempts. The pertinacity which kept him at the search for the suspected effect remained one of his most striking characteristics. The announcement of the discovery was received with the greatest interest. Of it Kelvin said in commenting on Hall's paper at the York meeting of the British Association in 1881: "The subject of this communication is by far the greatest discovery that has been made in respect to the electrical properties of metals since the times of Faraday—a discovery comparable with the greatest made by Faraday." A large number of other investigators rushed into the field thus opened. The three other analogous transverse effects bearing the names of Ettingshousen, Nernst and Righi-Leduc were speedily discovered, and a very extensive literature rapidly grew up.

Professor Hall himself continued to contribute papers on the new effect for eight years, but then turned for a considerable interval to other matters, mostly related to questions of thermodynamics, which was his principal field of graduate instruction. He was thus led to take up the thermo-dynamic analysis of thermo-electric phenomena, to which he contributed new points of view. In his attempt to understand the mechanism of these phenomena he was confronted with the whole problem of the theory of electrical phenomena in metals. He had the vision to realize that the significance of the Hall phenomenon and the other transverse effects had not been adequately appreciated, and his scientific life from 1910 on was dedicated with rare singleness of purpose to creating a theory of electrical phenomena in metals which should include thermo-electric and the transverse phenomena as well as those more usually considered. Part of his program demanded better numerical values for the various transverse coefficients. The exact measurement of these coefficients is admittedly one of the most difficult tasks which an experimental physicist can set himself, but with marvelous spirit Professor Hall undertook the problem after the construction of the new Research Laboratory for Physics at Harvard in 1931, and had succeeded in measuring the four coefficients for a number of metals as a function of temperature with an accuracy which satisfied his exacting requirements. He was actively engaged on this work up to within a few weeks of his death.

His theoretical work has probably never received the attention that it deserved because it was written in an idiom of his own, not familiar to most theoretical physicists. For a number of years before his death he had been attracted by the idea of collecting his theoretical results into a book, and actually was on the verge of publication a couple of times, but finally last summer (1938) he issued a book of 170 pages, considerably smaller than he had at one time contemplated, entitled, "A Dual Theory of Conduction in Metals," published by the Murray Printing Company, Cambridge. This book, I think, will be found to be much more readable than many of the original papers, and to be well worthy of intensive study. It should not be difficult to put into the language of present quantum theory many of Professor Hall's points of view. It was a particular gratification to him toward the end of his life that quantum theory found itself naturally driven to a point of view on the importance of which he had always insisted, namely, that conduction phenomena can not be understood without considering the rôle of the positive ions in the metal as well as the free electrons.

Those who knew him personally will feel a loss greater than can be accounted for by any scientific eminence. It will be agreed, I believe, that his outstanding personal characteristic was his utter honesty and integrity, coupled with an independence and strength of character which enabled him to trust his own judgment and steer his own course once he had made his carefully reasoned decision. Combined with this was a very unusual reluctance to force his own views on others; he truly treated the opinions of others as equally worthy of respect with his own. He was unobtrusively but consistently and persistently religious, with a strong sense of civic duty. He served in executive positions of importance in a number of community enterprises, and his volunteer services at the time of the Boston police strike will be long remembered. His conversation was often enlivened by a refreshing wit, and his writings by a felicity that made them a pleasure to read. His satisfaction with writing as a means of expression probably went back to his college years, for he described himself as the most prolific editor of the college paper, and refers to writing as the only talent he may have had in college. On occasion he was capable of effective verse. Those who knew him more intimately knew that he had passed through dark times of discouragement or even despair, over which he triumphed by sheer force of character. Sometimes they were permitted glimpses of a depth and quality of sentiment rare and moving.

His friends will not soon forget the erect vigor of his old age, or cease to be thankful that his last illness was not protracted.

P. W. BRIDGMAN

HARVARD UNIVERSITY

SCIENTIFIC EVENTS

THE FIRST HIGH-POWERED RADIO STATION WITHOUT STATIC

THE first high-powered radio station without static, employing an improved system of transmission and reception which, if widely adopted, will take the place of radios now in use, will be put into operation next spring, according to an announcement made by Major Edwin H. Armstrong, professor of electrical engineering in Columbia University, who designed and built the broadcasting equipment.

The new system will greatly relieve the danger of the air waves being monopolized, which has given so much concern to the Congress, by making available a service on the ultra-high frequency channels that are comparatively unused at present.

Arrangements have been made with station WQXR for the new station to receive and transmit the programs now broadcast from New York's "High Fidelity" station. John V. Hogan, radio engineer and owner of WQXR, has filed a petition with the Federal Communications Commission for permission to build a frequency modulated station in New York City. The studios and programs of WQXR will be used by W2XMN until such a time as Mr. Hogan's own station is erected.

Construction of frequency modulated receiving sets of the new type, which were at first labeled an "impractical dream" by radio corporations, has already been started on a commercial basis by the General Electric Company. The new sets, when produced on a quantity basis, will cost no more than the ordinary good set of to-day and will be able to receive both the old and the new kinds of broadcasting much the same as sets now receive both the short and long-wave programs. Arrangements are being made for the manufacture and sale of transmitters by the Radio Engineering Laboratories of Long Island City. Patents on the system have been granted to Major Armstrong in the important countries of the world.

The invention was publicly demonstrated before the Institute of Radio Engineers in 1935. At that time a sound reel recording was played comparing the reception during a thunder-storm of the old and new types of broadcasting. The recording was made from broadcasts received at a distance of 85 miles from the 2-kilowatt station in the Empire State Building, using the new method, and from WEAF, a 50-kilowatt station. While WEAF came through strongly, its program was made unintelligible by crashes of static. In contrast, the frequency modulated signals from the Empire State Building provided an uninterrupted, clear program, free from static, despite the fact that its power was only 4 per cent. that of the larger station.

Major Armstrong states that great credit for the development work necessary to perfect the high quality of the transmission must go to John Bose and James Day, two of his assistants. Apparatus for the station was designed in the Hartley research laboratories at Columbia University, where the most delicate parts were made. The remainder of the equipment was constructed at the Radio Engineers Laboratory in Long Island City and the RCA Manufacturing Company of Camden. Major Armstrong paid the highest tribute to the engineering skill of John Evans, of the RCA Company, who designed the high-power equipment and to Perry H. Osborn, who assisted in the construction.

The new station, built at a cost of several hundred thousand dollars, is owned by Major Armstrong. He first started to work on the problem of eliminating static from radio broadcasts in 1914 in collaboration with Professor Michael I. Pupin, after whom the Pupin laboratories at Columbia are named. Both men gave up the problem in 1922, convinced that there was no solution. A year or two later Major Armstrong started to look for a solution from a new angle that eventually led to the present discovery.

GRANTS OF THE NATIONAL FOUNDATION FOR INFANTILE PARALYSIS

THE National Foundation for Infantile Paralysis has announced grants of $140,990 to universities and hospitals. They are as follows:

For Scientific Research

Department of Internal Medicine, Yale University Medical School, $6,500.
Long Island College of Medicine, Brooklyn, $15,000.
Department of Bacteriology, University of California Medical School, Los Angeles, $5,000.
Department of Bacteriology, University of Southern California Medical School, $10,000.
Department of Bacteriology, Stanford University, California, $12,000.
University of Michigan, Ann Arbor, $2,000.
University of Wisconsin, Medical School, Madison, $3,300.
Department of Bacteriology, Ohio State University, Columbus, $3,060.
Western Reserve University, Cleveland, $4,800.
Washington University, School of Medicine, St. Louis, $6,800.
Grasslands Hospital, Valhalla, N. Y., $7,500.

For Prevention and Treatment of After Effects

Orthopedic Hospital-School, Los Angeles, $7,800.
Children's Hospital-School, Baltimore, $7,500.
St. John's Hospital, Springfield, Ill., $2,500.
Michael Reese Hospital; Samuel Deutsch Serum Center, Chicago, $4,600.

James Whitcomb Riley Hospital, Indianapolis, $6,000.
Children's Hospital, Marlin, Texas, $2,500.
Society of New York Hospital, New York, $4,580.
University Hospital of Iowa, Iowa City, $8,500.
Hospital for Joint Diseases, New York City, Dr. Leo Mayer, surgeon in chief, $4,250; Dr. Samuel Kleinberg, $5,800; Dr. Samuel Johns and Dr. Isador Zadek, $5,500; Dr. Jerome Weiss, director of division of poliomyelitis research, $5,500.
Scottish Rite Hospital, Dallas, Texas, $10,000.

The grants for research were made upon the recommendation of an advisory committee headed by Dr. Thomas M. Rivers, director of the hospital of the Rockefeller Institute for Medical Research. Dr. Philip Lewin, associate professor of orthopedic surgery at the Medical School of Northwestern University, was chairman of the committee which directed distribution of the grants for treatment.

Grantland Rice is chairman of a committee for raising funds prior to the birthday balls of President Roosevelt on January 30. This year the funds will be divided in half, one part to remain in the localities where the money is raised and the other half to be sent to the National Foundation for Infantile Paralysis for support of research and new treatment.

THE ANNUAL MEETING OF THE SOUTHWESTERN DIVISION

THE nineteenth annual meeting of the Southwestern Division of the American Association for the Advancement of Science will be held from May 2 through May 5 at Alpine, Texas. Host institutions will be the Sul Ross State Teachers College and the new McDonald Observatory, the latter being located on top of Mt. Locke, 42 miles from Alpine. Presentation of papers in the various sections will be held at Alpine during the first three days, with the fourth to be spent at the observatory.

Alpine is located in the Big Bend region of Texas, almost due east of El Paso at a distance of 225 miles. It is on one of the main east-west highways (U. S. 90), all paved. The McDonald Observatory is a joint enterprise of the University of Texas and the University of Chicago, with Dr. Otto Struve as director. The principal telescope is a reflector of 82-inch aperture, second only in size to the 100-inch telescope of Mt. Wilson.

A partial list of other professional organizations which will meet in conjunction with the division are as follows:

Mathematical Association of America, southwestern section, *chairman*, R. S. Underwood, Lubbock.
Society of American Foresters, southwestern section, *chairman*, E. R. Smith, Albuquerque.
West Texas Historical and Scientific Society, *chairman*, Henry T. Fletcher, Marfa.
Texas Academy of Science, *chairman*, W. T. Gooch.
Texas Folk Lore Society.
Texas Archeological and Paleontological Society, Abilene, *chairman*, Dr. Cyrus N. Ray, Abilene.

Due to the fact that the meetings have been scheduled to coincide with the dedication ceremonies of the observatory, and that so many organizations from the eastern part of Texas will participate, the exact schedule of the program is still in the formative state. Regular features of the division meetings include the Powell Lecture, to be delivered this year by Dr. A. H. Compton, of the University of Chicago, on the topic "Physics Views the Future"; the presidential address, to be given by Dr. E. F. Carpenter, Steward Observatory, University of Arizona, and the division banquet. In addition, the Texas Academy of Science plans to hold a dinner meeting with a special speaker.

The schedule for Friday, May 5, promises to be unusually interesting with an astronomical symposium at Mt. Locke in the afternoon, a "chuck wagon" supper, and open house to the division members at the observatory that evening.

Many of the visitors will want to stay over until Saturday, May 6, to hear the symposium on "Galactic and Extra-Galactic Structures," which is being held by fourteen of the most distinguished scientists of this continent and Europe under the auspices of the observatory staff.

Field trips of special interest to biologists geologists, anthropologists and historians are being arranged. The Big Bend of Texas is rich in early Spanish colonial history, being the region of five major Spanish expeditions. Over this is spread the events of Mexican authority, early Texas history and some of the latest conflicts of the U. S. Army and hostile Indians. Pre-history is represented by many evidences of primitive man, and in late years a large number of expeditions from archeological museums have established excavation sites of much interest to anthropologists. Within but a short distance from Alpine are to be found geologic structures of every description, as a consequence of which there is a large range in variety of life forms, all the way from those of the hot desert to those of the mountain tops.

The chairman of the Local General Committee is Victor J. Smith, director of the Big Bend Museum of the West Texas Historical and Scientific Society. C. T. Elvey is chairman of the committee in charge of activities at the observatory. Papers to be presented before the various section meetings must be in the hands of the respective chairmen of the sections by the first of April. Complete programs will be mailed to all members and all those presenting papers a week in advance of the meetings. Any special requests for programs should be sent to the secretary of the division.

V. C. KIECH,
Secretary

UNIVERSITY OF NEW MEXICO

THE AMERICAN INSTITUTE OF THE CITY OF NEW YORK AND THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

AFFILIATION of the American Institute of the City of New York was voted by the council of the American Association for the Advancement of Science at Richmond on December 27. This affiliation is on the same basis as the association's affiliated state academies. The American Institute was chartered in 1828 "for the purpose of encouraging and promoting domestic industry in New York State and in the United States."

At a subsequent meeting of the Association of State Academies, Professor E. C. L. Miller, of the Virginia Academy of Science, was authorized to appoint a committee to work with representatives of the American Institute in arranging plans whereby the American Institute may cooperate with the state academies and their junior academies in activities of mutual interest.

The American Institute conducts separate programs for each of its three groups of members. For adults it presents, popular demonstration meetings, round-table discussions, symposia, forums and dinners. Annually, since 1932, it awards its gold medal to an individual or corporation in order to "suitably recognize meritorious achievements in science, industry, engineering or architecture that have a broad incidence on human welfare." The gold medal for 1938 will be awarded to the Sperry Gyroscope Company for outstanding achievement in the design and manufacture of instruments for navigation resulting in greater safety both in the air and on the sea.

Each year, the American Institute gives one or two fellowships to "persons who have done outstanding work in the interpretation of scientific, engineering or industrial achievement which promotes effectively the knowledge and general understandng of these arts and sciences." For 1938, the fellowships are awarded to Dr. Ross A. Baker, professor of chemistry at the College of the City of New York, for the promotion of better teaching and evidence of deep appreciation of the problems of students in colleges, and to James T. Grady, director of the department of public information of Columbia University, for his pioneer work in promoting accuracy of science reporting through the press.

Separately organized within the American Institute are its associate members between 18 and 25 years of age. They have their own officers and committees, and they plan their own programs and social events. Most of them are college students or graduates already specializing in some branch of science. They take part in round-table discussions, field trips, member demonstrations and general meetings.

One of the most vital parts of the work of the American Institute is its science and engineering clubs. As described in the issue of SCIENCE for December 2, 1938, these are a recent expansion of the program it has fostered in New York City and vicinity for eleven years. New funds have become available for the work of establishing and aiding science clubs elsewhere, for assisting in organizing workshop courses, science congresses, photographic exhibits and science fairs. The official publication of the American Institute Science Clubs is the *Science Observer*, a monthly newspaper carrying columns devoted to youth research projects, up-to-date news in science and club activities.

The American Institute, now 111 years old, conducted the first New York County Fair in the Masonic Hall in New York City on October 24, 1828, to encourage manufacturers and inventors in the United States, and to bring the public's attention to the varieties and excellence of goods made in America. At its subsequent county fairs, which are still held each year as the school science and engineering fair, the American Institute introduced to the public the Morse telegraph, the Hoe press, the Mason and Hamlin organ, the McCormick reaper and the Singer sewing machine.

Congressman James Tallmadge (1778–1853) was one of the founders of the institute and was its president from 1831 to 1850. He also served as Lieutenant-Governor of New York State in 1825 and helped to found New York University. He was a staunch supporter of the Whig doctrine of the protection of growing American industry. Other distinguished officers and members famous in American history were Daniel Webster, Henry Clay, Cornelius Vanderbilt and Peter Cooper. Horace Greeley was its president from 1866 to 1871. In its early days the membership of the American Institute was from ten to fifty. It held its early meetings in Tammany Hall and later in Broad Way House. Its fairs were at one time held in Castle Gardens, now the New York City Aquarium.

AWARDS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS

AT the eighty-sixth annual meeting of the American Society of Civil Engineers in New York City the Hoover Medal was presented to John Frank Stevens, formerly chief engineer of the Panama Canal. The medal was received for Mr. Stevens by his son, Donald F. Stevens, of Baltimore, a past president and honorary member of the society, superintendent of transportation of the Baltimore and Ohio Railroad. Gano Dunn, past-president of the American Institute of Electrical Engineers, made the presentation, and Ralph Budd, president of the Burlington and Quincy Railroad, spoke of Mr. Stevens's achievements.

Other medals and prizes were awarded as follows: The Norman Medal to Professor Hunter Rouse, of the California Institute of Technology; the James R.

Croes Medal to E. C. Hartman, of the Aluminum Research Laboratories of New Kensington, Pa.; the James Laurie Prize to Leon S. Moisseiff, who designed the Queensboro and Manhattan bridges and was consultant on such bridges as the George Washington, Golden Gate, Whitestone and many others.

The Arthur M. Wellington Prize was presented to Charles M. Noble, engineer, for the Pennsylvania Turnpike Commission, Harrisburg; the Collingswood Prize for Junior Engineers was presented to Douglas M. Stewart, of the Ingersoll-Rand Company, New York.

Five honorary memberships, given to outstanding engineers, were conferred on the following: C. Frank Allen, professor emeritus, Massachusetts Institute of Technology; Anson Marston, past-president of the society and dean emeritus of engineering, Iowa State College, Ames, Iowa; Arthur S. Tuttle, past president of the society, who has spent most of his life in the service of New York City in an engineering capacity; Frank E. Weymouth, general manager and chief engineer of the Metropolitan Water District of Southern California, who has just completed the Los Angeles Aqueduct, and Edward E. Wall, director of public utilities for St. Louis, who was represented by F. G. Jonah, chief engineer for the St. Louis-San Francisco Railway.

SCIENTIFIC RESEARCH UNDER THE FEDERAL GOVERNMENT

ACCORDING to an Associated Press dispatch, President Roosevelt commended "to the consideration of the Congress" on January 23 a compilation of the activities of federal agencies in the field of research.

The report, prepared by the National Resources Committee, discussed federal research in medicine, agriculture, economics, public administration, etc. It suggested the coordination of such efforts.

Mr. Roosevelt's message follows:

I transmit herewith for the information of the Congress a report entitled "Research—A National Resource" compiled by the National Resources Committee.

This report deals with the relation of the Federal Government to research. Subsequent reports in this field will cover research by colleges, universities and foundations, by business organizations, by the industrial laboratories and by the state and municipal governments.

The dependence of civilization on science is universally recognized, but the extent of the activities of private and public agencies carrying on scientific inquiry is not generally known. It is unlikely that large numbers of our people have any adequate realization of the services which are being rendered by the executive agencies of the Federal Government through scientific researches in medicine, agriculture, economics, public administration and the other natural and social sciences.

This report indicates the new emphasis in recent years on activities in the social science fields and stresses the need for effective coordination of all agencies engaged in research in order to achieve the solution of many of our more difficult problems.

I commend the report to the consideration of the Congress.

In the report, the committee recommended these steps:

Further studies on work of the advisory committees which cooperate with federal research agencies and on research being done by states and municipalities.

Improvement in methods of recruiting research workers for government service.

Authorization for government research agencies to contract for cooperation with recognized private research organizations.

Financial support for international scientific meetings and encouragement of American participation in them.

Organization of government research so as to avoid the possibilities of bias.

Encouragement of decentralized research outside of the government.

Further interrelation of governmental research agencies by organization of central councils similar to those formed by private research.

SCIENTIFIC NOTES AND NEWS

DR. EDWARD R. WEIDLEIN, director of the Mellon Institute, Pittsburgh, Pa., has been presented with a Meritorious Service Medal of the State of Pennsylvania for "his outstanding contributions to industrial science."

DR. ARNO B. CAMMERER, director of the National Park Service, received the gold Cornelius Amory Pugsley Medal for park service in 1938 at the forty-fourth annual meeting in New York City on January 16 of the American Scenic and Historic Preservation Society.

THE Oersted Medal of the American Association of Physics Teachers, established through the generosity of an anonymous donor, was awarded for 1938 to Professor Alexander Wilmer Duff, professor emeritus of physics at the Worcester Polytechnic Institute. The award was made at the annual meeting of the American Association of Physics Teachers in Washington, D. C., on December 30.

THE Robert W. Hunt Award of the American Institute of Mining and Metallurgical Engineers for 1939 will be made to K. C. McCutcheon and John Chipman for their paper on "Evaluation of Gases from Rimming-Steel Ingots." The award of the Institute of Metals Division will be made to Frederick N. Rhines and Robert F. Mehl in recognition of their paper on "Rates of Diffusion in Alpha Solid Solutions of Copper."

THE Duddell Medal of the Physical Society, London, has been awarded to Robert W. Paul in recognition of his work in the manufacture of electrical measuring instruments and in the development of the cinematograph.

DR. ARNAUD DENJOY, professor of mathematics at the University of Paris and exchange professor at Harvard University for the current academic year, has received the Prince de Monaco Prize from the Academy of Science of the Institut de France. The prize, which was established in 1924 by Prince Albert I of Monaco, carries an award of 100,000 francs and is given in recognition of distinguished work in the field of mathematics.

DR. MAX BODENSTEIN, professor of physical chemistry at the University of Berlin, has been elected an honorary member of the Swiss Chemical Society.

DR. GEORGE W. LEWIS, since 1924 head of the aeronautical laboratories at Langley Field, Va., and research director of the National Advisory Committee for Aeronautics, has been elected president of the Institute of Aeronautical Sciences. He succeeds T. P. Wright, vice-president and director of engineering of the Curtiss-Wright Corporation.

THE following have been elected officers of the College of Physicians of Philadelphia for the year 1939: *President,* George P. Muller; *Vice-president,* Edward B. Krumbhaar; *Secretary,* J. Harold Austin; *Treasurer,* T. Grier Miller; *Honorary Librarian,* Albert P. Brubaker; *Censors,* George E. de Schweinitz, John H. Gibbon, Thomas R. Neilson and Francis R. Packard; *New Councilors,* Eugene P. Pendergrass and Truman G. Schnabel.

AT the annual meeting in Toronto on January 17 of the Royal Astronomical Society of Canada officers were elected for 1939 as follows: Dr. William Findlay, professor of mathematics, McMaster University, Hamilton, Ontario, was reelected president. Dr. J. A. Pearce, Dominion Astrophysical Observatory, Victoria, B. C., and Dr. Frank S. Hogg, David Dunlap Observatory, University of Toronto, were elected vice-presidents. E. J. A. Kennedy, Toronto, was elected general secretary, and J. H. Horning, Toronto, treasurer.

W. REDMOND CROSS, president of the New York Zoological Society, has been elected chairman of the council of the American Geographical Society of New York. He succeeds Philip W. Henry, who resigned recently after serving for seventeen years.

AT the seventieth annual meeting of the board of trustees of the American Museum of Natural History, F. Trubee Davison was reelected president of the board. A. Perry Osborn was elected first vice-president. Mr. Osborn, a son of the late Professor Henry Fairfield Osborn, has served as trustee for eighteen years and has been executive chairman of the ten-year development program since its inception in February, 1937. Other officers reelected include: Cleveland E. Dodge, *second vice-president;* E. Roland Harriman, *treasurer,* and Clarence L. Hay, *secretary.* J. P. Morgan resigned as a trustee after a service of thirty years. During his trusteeship he has been vice-president, a member of the finance committee, of the buildings and plans committee, of the nominating committee, of the executive committee and of several special committees.

DR. WALTER DILL SCOTT, since 1920 president of Northwestern University, has presented his resignation to the trustees. He expressed the hope that his successor might be elected so as to permit his retirement in the autumn. Before becoming president, Dr. Scott had been connected with the university since 1900, successively as instructor, assistant professor and professor of psychology and director of the psychological laboratory.

DR. EDWIN COOPER VAN DYKE, since 1913 professor of entomology at the College of Agriculture of the University of California, will retire at the close of the academic year.

DR. WILLARD C. FLEMING, assistant dean of the College of Dentistry of the University of California, will become dean of the college at the conclusion of the present college year.

AT Western Maryland College S. B. Schofield, professor of chemistry and formerly dean of the college, has been appointed to the newly created position of dean of administration, and Dr. L. M. Bertholf, professor of biology and formerly dean of freshmen, has been appointed dean of the college.

DR. NORMAN CAMERON, associate in psychiatry in the Johns Hopkins Medical School and resident psychiatrist in the Johns Hopkins Hospital, has resigned to take charge of the laboratory for experimental psychology and psychopathology at the Payne Whitney Clinic of the New York Hospital. He has been appointed associate professor of psychology in the Cornell University Medical College and assistant attending psychiatrist in the New York Hospital.

PROFESSOR RAYMOND L. TAYLOR, associate professor of biology at the College of William and Mary, has been appointed Kenan visiting professor in the department of zoology of the University of North Carolina for the remainder of the present college year.

IT is announced in *Nature* that Dr. Erwin Schrödinger, professor of theoretical physics at the University of Graz, Austria, has been appointed by the Fondation Francqui as a visiting professor for the next six months to a "Chaire Franqui" in the University of Ghent.

DR. CHARLES F. NASSAU, chief surgeon of Frankford Hospital and clinical professor of surgery at the Jefferson Medical College, has been appointed director of public health in Philadelphia.

DR. TREVOR KINCAID, chairman of the department of zoology of the University of Washington, has become a member of the staff of the Oceanographic Laboratories at Friday Harbor. He will offer a course on marine plankton during the regular summer session, from June 19 to August 19.

SIR FRANK E. SMITH will relinquish on January 31 his position as secretary to the Committee of the British Privy Council for Scientific and Industrial Research. The King has approved the appointment of Dr. E. V. Appleton, Jacksonian professor of natural philosophy in the University of Cambridge and fellow of St. John's College, to succeed Sir Frank.

THE *Lancet* states that Professor Julius de Darányi, director of the Hygiene Institute of the Royal Hungarian Péter Pázmány University of Budapest, has been appointed president of the Hungarian Postgraduate Medical Education.

DR. WILLIAM FINDLAY, McMaster professor of mathematics at the University of Toronto, gave on January 24 his address as president of the Royal Society of Canada. The address was entitled "Mathematics and Astronomy."

DR. WILLIAM R. AMBERSON, professor of physiology at the School of Medicine of the University of Maryland, spoke at a meeting on January 27 of the Philadelphia Branch of the American Association of Scientific Workers on "Cooperative Farming in American Agriculture."

THE Regius professorship of surgery in the University of Glasgow will become vacant on October 1, owing to the expiration of the tenure of office of Professor Archibald Young. Applications for the chair should be addressed to the Private Secretary, Scottish Office, Whitehall, London, S.W.1, and should reach him not later than March 15.

CORNELL UNIVERSITY has announced the establishment of the Henry Strong Denison graduate fellowships in agriculture, in memory of Henry Strong Denison, a graduate of Cornell University in the class of 1905. These fellowships were created by a gift from the Henry Strong Denison Medical Foundation, Inc., founded by Mrs. Ella S. Denison. Three fellowships with an annual stipend of $1,000 each will be awarded in the fields of the plant sciences, animal sciences and social sciences and agricultural engineering, for the purpose of encouraging young graduate students "who are especially gifted and qualified to carry on research work in the science of agriculture." Applications must be filed in the office of the Graduate School before March 1.

E. I. DU PONT DE NEMOURS AND COMPANY will award six post-doctorate fellowships for fundamental research in organic chemistry and eighteen post-graduate fellowships for research in the field of chemistry for the academic year 1939–40. The post-doctorate fellowships are for $2,000 each, while the eighteen post-graduate fellowships are for $750 each. Fellowships to cover advanced work in the field of chemistry have been made for a number of years by the du Pont Company. The purpose of the plan is to promote the advancement of science and to cooperate with the educational institutions in their efforts to carry on advanced research work. These fellowships do not restrict research to subjects connected with the products of the company. The colleges select not only the beneficiary of the fellowships, but also the subject of the research.

AWARDS from the Elizabeth Thompson Science Fund were reported in SCIENCE on May 20 and earlier. The next meeting of the trustees will be held in April. Applications for grants should be made to the Secretary, Dr. Jeffries Wyman, Jr., Biological Laboratories, Harvard University, Cambridge, Mass.

THE University of California has received gifts amounting to $122,000. This sum includes: from the estate of John E. Cox, $63,085 for medical research; from the estate of William Wilson Karson, for the university hospital, $50,000; from the Rockefeller Foundation, for the radiation laboratory, $3,750; for the Institute of Child Welfare, $3,490; for the research of Herbert M. Evans, $3,750; for the Institute of Social Sciences, $2,500; from the Fruit Growers Supply Company of Los Angeles, $2,500 for research in orchard heating by the division of agricultural engineering at Davis.

DR. H. A. B. DUNNING, director of the research laboratory and president of Hynson, Westcott and Dunning, Baltimore, has given $50,000 toward the construction of a research laboratory for the department of science of Washington College, Chestertown, Md. An initial gift of $50,000 towards the library was made some time ago by Dr. George A. Bunting, of Baltimore.

MISS ANNIE-MAY HEGEMAN, of New York and Lenox, Mass., has given to the Library of Congress and the Smithsonian Institution the sixteen-room residence of her stepfather, the late Representative Henry Kirke Porter, of Pennsylvania. Asking that the funds from the sale of the property at Sixteenth and I Streets, Northwest, be recorded as a memorial to

Mr. Porter, Miss Hegeman directed that the money be divided equally between the two institutions and used for the "increase and diffusion of knowledge."

THE late Charles E. Munroe, who was the last surviving charter member of the American Chemical Society, has left to the George Washington University, Washington, D. C., his library on chemistry and explosives, consisting of 505 bound volumes, 2,627 unbound volumes and pamphlets, and some thousands of clippings.

CAPTAIN ALLAN HANCOCK has presented the exploration cruiser *Velero III* to the University of Southern California. The vessel and its endowment go to the university as companion gifts to the Allan Hancock Foundation for Scientific Research established a year ago, a building for which is now being constructed. All steel from stem to stern the *Velero III* is 198 feet in length with 30-foot beam, powered by twin Diesel engines and fuel capacity for a 10,000-mile non-stop cruise. Fresh food and water storage is ample to supply thirty men on a three-months voyage. For the past eight years annual voyages have been made in the eastern Pacific. The vessel will continue her exploration work and will also serve for instructional purposes in nautical subjects.

IT is stated in *Nature* that the annual report of the Institute for Science and Labor, which was transferred from Kurasiki to Tokyo at the end of 1936, indicates that much of the work of the institute follows the lines of work of the National Institute of Industrial Psychology in Great Britain. Among a number of completed researches mentioned in the report are those on the clothing of farmers, syphilis morbidity in villages, psychological qualifications for textile workers, an examination of vocational testing methods, studies on manual dexterity and on the physical fitness of employees, studies on motions and positions in working, on repetition work, psychological differences between skilled and unskilled workers in a weaving factory. Some of the physiological work is on lines similar to those pursued by the Industrial Health Research Board in Great Britain as, for example, the investigations on environmental conditions, such as climate, the effect of occupational activities on basal metabolism, the metabolism of heavy muscular labor or the physiological studies on walking, but in addition the institute has completed a preliminary research on the daily protein requirements of the nation. Occupational diseases and the prevention of accidents have also received attention, and it is noted in abstracts of publications of the institute included in the report that scientific workers in Japan are now advocating on scientific grounds raising the minimum age of juvenile labor to at least fourteen years, with special protection up to eighteen years of age.

DISCUSSION

UNDERTOW[1]

IN a recent article[2] Professor O. F. Evans contributed some interesting data in regard to undertow. He showed by means of colored water that in small bodies of water with an on-shore wind there was a return of a subsurface current to counteract the on-shore current at the surface. These movements were all slow and were all observed in relatively smooth water. However, Evans suggested that these currents might become strong under storm conditions producing an "undertow" which might be dangerous to bathers.

Previously Shepard (SCIENCE, 84: 181–82, 1936) had suggested that this dangerous "undertow" was probably a myth based on the existence of river-like currents which move perpendicularly out from the beach in many localities. These flows, which are called "rip currents" or "rip tides" are in no sense undertow since like streams their principal movement is in the upper water. The existence of dangerous "undertow" was questioned chiefly because of failure to obtain reports from life guards or swimmers that it existed, and also because, as Professor W. M. Davis (SCIENCE, 61: 206–08, 1925) had shown, wave motion produces both a forward and backward movement along the bottom. However, in view of the experiments cited by Evans it seemed highly desirable to make further investigation of the nature of subsurface currents, particularly under storm conditions.

The opportunity to make these tests was provided by the 1,000-foot Scripps Institution pier. For the past year the writers, with the help of WPA assistants, have been taking daily soundings along this pier, using a machine which rolls along the rail and has a sounding arm which extends out for 10 feet from the pier. To the sounding line on this machine a wooden frame like that in Fig. 1 was attached. This frame has a large vane at the bottom which is moved in the direction of the prevailing current. At the top is a smaller vane which serves to tell the direction in which the large vane is pointing under the water. A heavy weight was suspended at the bottom of the line to dampen the surge of the waves. This device could be raised or lowered to any depth desired and thus could show the nature of the water movement at the various depths. Also it could be moved all along the pier by means of

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[1] Contributions from the Scripps Institution of Oceanography, New Series, No. 39.

[2] SCIENCE, 88: 279–81, 1938.

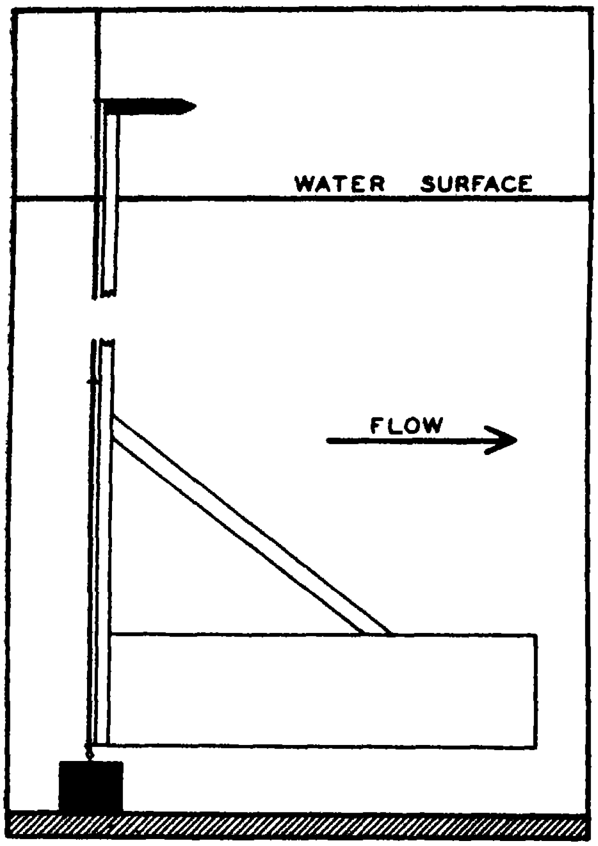

FIG. 1

the movable sounding machine. This carried observation out to depths of about 22 feet.

Choosing two days when there was a strong on-shore wind and fairly large waves numerous tests were made. The directions were easily observed and seemed to leave no doubt as to conditions existing at these times. In all cases the current was essentially the same at the surface as at the bottom. For the most part the current was moving to the south along the shore.

In some places near shore within the range of the breakers outward moving currents were observed, but these were always shown both at the surface and on the bottom. They can be considered as a type of rip current.

Observations with a current meter at the end of the pier in about 25 feet of water showed also that the current had a longshore trend in the same direction as the current at the surface. On the other hand, a bottom current, observed by R. Revelle and R. H. Fleming on another occasion when there was no wind, flowed contemporaneously with the outward movement of a rip current. On this occasion the bottom current was longshore, indicating that the rip current had passed over the bottom water without disturbing it. This of course represents a case that is the opposite of undertow.

These observations suggest that dangerous undertow is not an accompaniment of strong on-shore winds and large waves. However, they are of too limited scope to prove the absence of this danger to bathers. It is to be hoped that Professor Evans and others interested will extend these experiments to lakes and other parts of the ocean. Meantime the bather is still in danger from the rip currents which may carry him out beyond his depth, even if they do not carry him below the surface. The rip currents incidentally are observed under all sorts of conditions of waves, currents and winds.

F. P. SHEPARD
E. C. LAFOND

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SURVIVAL OF THE TROPICAL RAT FLEA IN UNITED STATES

SINCE July, 1934, when Roudabush and Becker[1] reported the tropical rat flea (*Xenopsylla cheopis*) from the interior of the United States, several other reports have established its presence from the East, Mid-west and Far West. The evidence given in these papers leaves one with the impression that the flea is well established, but as yet no one has proved that the flea does not migrate into the interior every year.

Realizing that such a question must some time be answered, Dr. E. R. Becker and the author continued to collect the fleas at Ames, Iowa, every year from 1934 to 1938. In order to check its presence thoroughly, they were collected every fall until snow covered the ground and every spring as soon as possible after the first thaw. These collections prove that the flea is not a periodic visitor but is actually a resident in the interior.

In August, 1938, several specimens of the tropical rat flea were sent to Ward's Natural Science Establishment for identification. These came from Youngstown, Ohio, and since Ewing and Fox[2] have already reported that infestation no further details are necessary.

Several workers, cleaning out an infestation of insects in a Rochester, N. Y., church, brought into Ward's some of the insects for identification. Among other things three female specimens of the flea under consideration were found in a chandelier of the inverted dome type. Exactly how or why the fleas happened to be there is not understood, but there is some evidence that at least one of them underwent some development while in the chandelier, since a deserted pupal case was found in the debris.

Ewing and Fox[2] state that "there is a possibility that a more resistant race of this flea has been developed in some of our northern ports, such as New York and Boston and from there has spread to the Central states." Such a hypothesis is unnecessary. Freed, Jordan and Eckhoff[3] in reporting a case of endemic typhus fever in Des Moines, Iowa, sent the arthropods collected from rats in that locality to the author for identification. This material revealed the presence of *Xenopsylla cheopis, Liponyssus bacoti* and a species of *Hoplopleura* among other things. Dr. G. F. Ferris[4] identified the *Hoplopleura* as *H. oenomydis,* a species which has never been recorded in North America. The report by Freed, Jordan and Eckhoff established the fact that rats with their parasites might have been imported from the southern states, but since *H. oenomydis* has not even been found there it is just as logical to assume that the rats were imported directly to Des Moines.

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[1] R. L. Roudabush and E. R. Becker, SCIENCE, 80: 97, 1934.

[2] E. W. Ewing and Irving Fox, SCIENCE, 88: 427, 1938.

Thus it is felt that the spread of the flea could have been more easily accomplished by shipping on the Mississippi than by the cross-country travel from New York and Boston. This, accompanied by the fact that in most cases years and years of gradual exposure are necessary to create a race more resistant to cold, would appear to leave the hypothesis of Ewing and Fox without a basis.

Further, a brief thought on the subject should account for the survival of the flea in the colder temperatures of the temperate zone. It matters not how low the temperature falls as long as the flea, its larvae and eggs remain in the warm confines of the rat's tunnel. The same warmth which allows the rat to live can also keep the flea alive. In other words, a flea in a test-tube exposed to freezing temperatures is not any more at home than man deprived of his home, his clothing and his food, but we have long since ceased to marvel because man can survive freezing temperatures in his artificial environment.

ROBERT L. ROUDABUSH

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REDISCOVERY OF THE RHIZOCEPHALAN PELTOGASTER PAGURI ON THE NORTH AMERICAN COAST

FOR more than a century, the Rhizocephala, a group of degenerate parasitic Cirripedes, has engaged the attention of many European zoologists, but, with the exception of a few Sacculinidae described from the West Indies, there have been no studies made of these remarkable Crustacea from the Atlantic coast of North America. During July, 1938, at the University of Maine Marine Laboratory on Frenchmans Bay, Maine, I had the good fortune to discover a representative of the order Rhizocephala, *Peltogaster paguri* Rathke, parasitic on the abdomen of the hermit crab *Pagurus pubescens* Kröyer.

The geographical distribution of this parasite is considerable. It occurs along the entire European coast from Norway to the Mediterranean but is strictly a boreal species, more rare toward the southern edge of its range. Its chief host in Europe is *Eupagurus bernhardus* (Linneus), but it has also been found on *Eupagurus cuanensis* (Thompson), *Pagurus chiracanthus* Lilljeborg, and *Pagurus pubescens* Kröyer.

Peltogaster paguri was first recorded for North America by A. S. Packard, Jr.[1] (1866), who found a single specimen at Eastport, Maine. Another specimen was taken by the W. A. Stearns expedition at Henley Harbor on the coast of Labrador and recorded by S. I. Smith[2] (1884). In both cases the host was likewise *Pagurus pubescens*. No further American records are known.

Of a total of 341 *Pagurus pubescens,* consisting of 128 males and 213 females, which I examined from Frenchmans Bay this summer, 86 individuals (25 per cent.) bore the parasite *Peltogaster*. These were distributed as follows:

33 males, each carrying one Peltogaster
4 males, each carrying two Peltogaster
45 females, each carrying one Peltogaster
3 females, each carrying two Peltogaster
1 female, carrying three Peltogaster

The largest parasite obtained measured 21 × 12 mm, the average size being about 13 × 5 mm.

In many instances the Rhizocephalan was itself parasitized by another crustacean, one of the Epicaridea, *Liriopsis pygmaea* (Rathke). This isopod hyperparasite is new to American waters, but has been known as occurring on the same host along the coast of Northern Europe.

There are only two species of hermit crabs commonly found in Frenchmans Bay, the *P. pubescens* already mentioned and *P. acadianus* Benedict. Both occur on hard bottoms from near low water to 90 feet, with the former more common toward the outer bay and on the open coast, the latter more prevalent in the inner bay. It is significant that none of the 26 males and 46 females of *P. acadianus* which were examined, a goodly number from the same collecting grounds that yielded parasitized *P. pubescens,* showed any evidence of *Peltogaster*.

Abundant material to elucidate the embryonic development and larval stages of *Peltogaster,* the anatomy and life history of the imperfectly known *Liriopsis* and the effect of these parasites on their hosts has been collected and will be reported on elsewhere.

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[3] H. Freed, C. F. Jordan and D. Eckhoff, *Jour. Ia. State Med. Soc.*, 27: 425–426, 1937.

[4] G. F. Ferris, personal communication, 1937.

[1] A. S. Packard, *Mem. Bost. Soc. Nat. Hist.*, v. I, p. 295, 1866.

[2] S. I. Smith, *Proc. U. S. Nat. Mus.*, v. 6, p. 222, 1884.

EDWARD G. REINHARD

UNIVERSITY OF SCRANTON AND
UNIVERSITY OF MAINE MARINE
LABORATORY

NOMENCLATURE OF GONAD-STIMULATING HORMONES OF PLACENTAL ORIGIN

WE have recently obtained evidence[1] indicating that the rat may be added to a growing list of mammals whose foetal placentae secrete some type of gonad-stimulating hormone. By combining the evidence which has been accumulated from the horse, human being, monkey, chimpanzee and rat[2] it becomes apparent that the natural function of these chorionic secretions is to prolong corpus luteum function during pregnancy, and there is indirect evidence that a similar mechanism is operative in the mouse, rabbit and hamster.[3] This concept has been obscured, however, by the fact that when administered to foreign species, the known substances display great differences in the type of gonadal response which they produce.

These gonadotropic substances which arise from or are associated with the products of pregnancy are known by terms that in most cases are ambiguous and unduly cumbersome. Certainly the policy of using the name of a body fluid to designate a hormone, as for instance "pregnant mare serum" or "the urine of pregnant women," etc., is an example in loose terminology. It seems to us that in view of the fact that these hormones have a common tissue source and exercise a homologous function, the introduction of a generic term would conform to the facts and afford a satisfactory basis for a sound nomenclature.

We therefore propose that the term *cyonin* (Gr. kuo - pregnancy + hormone + protein) be applied to all those hormones of chorionic origin and of protein nature which act to sustain a female sex hormone balance favorable to the maintenance of pregnancy. This word used in conjunction with the name of the animal in which the hormone occurs would apply to any mammals where such a substance might exist. Thus "human cyonin" would replace such terms as "pregnancy urine," "pregnancy prolan" and "anterior-pituitary-like hormone" and "equine cyonin" such terms as "pregnant mare serum" and "endometrial scrapings of the mare," while "murine cyonin" would apply to the recently described placental hormone of the rat. Should more than one hormone be active in a given species, then qualifying terms may be added.

E. B. ASTWOOD,
Rockefeller Foundation fellow
in the Natural Sciences
R. O. GREEP

BIOLOGICAL LABORATORIES,
HARVARD UNIVERSITY

SCIENTIFIC BOOKS

CRYSTAL PHYSICS

A Text-book on Crystal Physics. By W. A. WOOSTER. Cambridge: At the University Press; New York: The Macmillan Company. xxii + 295 pp., 108 diagrams, $4.00.

IT seems that ever since Laue's discovery of x-ray diffraction crystallographers have been too busy to present an up-to-date treatment of those physical properties of crystals which are determined by microscopic rather than molecular symmetry. The experimental physicist and engineer interested in such properties as elasticity and piezoelectricity had to refer to the authoritative but cumbersome "Lehrbuch der Kristallphysik" by Woldemar Voigt, which was published in 1910 and was never translated into English.

In the foreword to a new printing of Voigt's book in 1928 Professor von Laue stated that the phenomenological theory of crystals could be greatly simplified by using the notation for components of higher-order tensors which the general theory of relativity has introduced into physics. He concluded that "whoever wants to make an improvement in that direction will have to write an entirely new book. But who among present-day physicists would delve into this subject with as deep an affection as W. Voigt?"

Dr. W. A. Wooster, of the Department of Mineralogy at the University of Cambridge, has finally taken up the challenge. He can be assured of the grateful interest of physicists and metallurgists as well as crystallographers and mineralogists. The fact that Wooster's book is very modest compared to Voigt's both in volume and in price will increase its appeal. The book is intended primarily as a text-book for students at universities, and presupposes "a knowledge of the elements of physics, mathematics and crystallography." "A two-fold object has been kept in view

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[1] E. B. Astwood and R. O. Greep, *Proc. Soc. Exp. Biol. and Med.*, 38: 713, 1938.

[2] H. H. Cole and G. H. Hart, *Am. Jour. Physiol.*, 93: 57, 1930; J. S. L. Browne and E. M. Venning, *Lancet*, 2: 1507, 1936; *Am. Jour. Physiol.*, 123: 26, 1938; R. E. Kirsch, *Am. Jour. Physiol.*, 122: 86, 1938.

[3] W. H. Newton, *Jour. Physiol.*, 84: 196, 1935; G. P. Heckel and W. M. Allen, SCIENCE, 87: 302, 1938; M. Klein, *Arch. Anat. Micr.*, 31: 397, 1935, *Arch. d'Anat. d'Histol. et d'Embryol.*, 18: 1, 1934 and *Proc. Roy. Soc.*, B. 125: 348, 1938.

—to present the classical treatment of the physical properties of crystals in terms of tensor notation and also to indicate the lines of development of modern theoretical and experimental research."

In the preparation expected of the reader as well as in the choice of the material treated the standpoint of the *mineralogist* prevails perhaps more strongly than would be indicated by the title and the author's preface. The physicist among the readers will easily find the necessary crystallographic information elsewhere; but the dearth of mathematical training presupposed forces the author to forsake the elegance of treatment which he could give to his subject on a more solid foundation of mathematical physics. On the other hand, a reader who does not even know about scalar and vector products will hardly be able to comprehend at all the transformation theory of higher-order tensors.

The greatest asset of the book is the close correlation between theory and experimental results given at each step of the development. Wherever possible, it is shown how the amount of observed physical anisotropy is connected with the atomic structure type of the substance. Although for most physical properties such considerations are still in a semi-quantitative state they show most impressively how much our understanding of the properties of solid matter has been advanced by x-ray structure analysis. Experimental methods are explained in principle, but the limited space does not permit detailed descriptions. A fuller selection of references to experimental procedures would have been very useful.

The general plan of the book is to treat in succession the phenomena which are described by a second-order tensor, a third-order tensor and a fourth-order tensor, respectively.

Chapter I (14 pages) contains the fundamentals of tensor notation and the limitations imposed by crystallographic symmetry on properties described by a second-order tensor.

Chapter II (48 pages) is entitled "Homogeneous Deformation; Thermal Expansion and Plastic Deformation." Chapter III (31 pages) is devoted to heat conduction and thermoelectric effects. The treatment of these fields, to which the author has made important original contributions, is excellent; much of the material presented will be new to most physicists. Electric conductivity of metallic crystals is dealt with very briefly; electric currents in semi-conductors and insulators are outside the scope of the book.

In Chapter IV, 33 pages deal with para- and diamagnetism. Detailed consideration is given to the determination of molecular susceptibilities of aromatic compounds. Dielectric phenomena are treated in eleven pages. The account of the electric properties of Rochelle salt disagrees at various points with more recent experimental results, especially those of the Zurich school and of H. Mueller, of the Massachusetts Institute of Technology.

Chapter V (60 pages), "Some Problems in Crystal Optics," is not intended as a systematic treatment of that great field but rather as a critical appendix to existing treatises on mineralogical optics. A good account is given of the beautiful work of W. L. Bragg, Hylleraas and others on the calculation of double refraction from atomic arrangement.

In Chapters VI (35 pages), "Piezoelectricity," and VIII (44 pages), "Elasticity," the advantages of tensorial notation are most apparent. The specialization of the matrices of piezoelectric and elastic constants for the different crystal classes is carried through in a straightforward way for all except the trigonal and hexagonal classes; for these an outline of the rather complicated proof is given. The methods used in the experimental determination of piezoelectric and elastic moduli are discussed; however, there is no rigid treatment of any case of inhomogeneous deformation. The account of applications of piezoelectric crystals is on a quite elementary level; it comes rather as an anticlimax to the preceding complicated mathematical derivations.

Chapter VII (9 pages), "Pyroelectricity," does not entirely remove the confusion which has been created by the unfortunate terms "false" and "true" pyroelectricity. After discussing the electric charges produced on quartz crystals by non-uniform heating, Wooster continues: (p. 227): "When the temperature of the crystal becomes uniform the stresses are much reduced (though not zero) and hence the charges also become much less." In the opinion of the reviewer this statement is not correct. A *uniform* change of temperature will produce no *stress* at all in any crystal. For a crystal without a singular polar direction like quartz the thermal *strains* are of such symmetry that *no* electric moment results.

The magnetic analogue to pyroelectricity, ferromagnetism, is not treated at all, although in no field of modern physical research have considerations of crystal symmetry been more fertile.[1]

A book covering a territory on the borderline between two branches of science can not possibly satisfy *all* the demands of its various readers. Wooster's "Crystal Physics" can be recommended as a most valuable supplement to existing text-books on mineralogy and crystallography and deserves the attention of every one engaged in crystal research.

HANS VON R. JAFFE

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[1] See for instance: F. Bitter. Introduction to Ferromagnetism, N. Y., 1937. Chapters V–VII.

INSECTS OF SUBTROPICAL FRUITS

Insects of Citrus and Other Subtropical Fruits. By HENRY J. QUAYLE. Comstock Publishing Company, Inc., Ithaca, N. Y. 1938. vii + 583 pp. Figs. 377. $5.00.

THIS treatise meets a need that has long been recognized by entomologists and fruit-growers who reside in subtropical regions. The significance of this statement will be appreciated particularly by individuals who have moved from temperate regions and engaged in the growing of subtropical fruits or engaged in pursuits dependent upon subtropical horticulture. Owing to the year-round mild temperature and the evergreen, everbearing, succulent nature of citrus and certain other subtropical fruits, insect control presents a more complicated problem than that known to the grower of deciduous fruits in temperate regions. The fight against insects infesting leaves, fruit and branches is continuous throughout the year in the growing of subtropical fruits. Treatments are rather expensive. In most districts at least one treatment annually must be made to citrus to control scale insects. A spray treatment costs about $25.00 an acre, and a fumigation treatment costs about $35.00 an acre. It behooves the grower to know the various insects, their life history and seasonal history, their degree of susceptibility or immunity to given insecticides, their natural enemies introduced and propagated by state and county agencies, and to know the facts and principles underlying or governing the effectiveness of insecticides and the application of insecticides.

For many years orchardists as well as entomologists, horticultural inspectors and pest control operators have had but limited sources from which to secure knowledge on the biology of insects affecting subtropical fruits and the diverse facts, concepts and practices concerned with the control of such pests. The most comprehensive treatise prior to Professor Quayle's book was "Insects Affecting the Orange," by H. G. Hubbard, a publication of 227 pages by the U. S. Department of Agriculture that appeared in 1885.

Professor Quayle has been an authority in the particular field for upwards of thirty years. In addition to notable work done in California, he has made two trips around the world on missions concerned with citrus insects. Coincident with the discovery of the Mediterranean fruit-fly in Florida and the work of eradicating it in 1929–30, he made a special survey of this pest in South Africa and the Mediterranean region. Appropriately, the book is world-wide in scope. The comparisons made of insect infestations in different regions and in relation to climatic conditions are of particular interest. The citrus insects of California have received special consideration. This is appropriate because in California pioneer work has been done in citrus fumigation, spraying, dusting, biological control, inspection and regulation.

The book has eighteen chapters. Chapter I gives brief characterizations of the various subtropical fruits, brief facts on the commercial production of such fruits in various parts of the world, a list of the principal insect pests of each fruit and a key to the principal citrus fruit insects and mites of the United States. Chapters 2 and 3 deal with citrus insects and mites of major importance, and Chapter 5 deals with citrus insects and mites of minor importance. Chapter 4 comprises a tabulated list of 33 species of Coccinellid beetles and 135 species of hymenopterous parasites that attack insects and mites of subtropical fruits. The tables also give data on host, stage attacked, region of the world from which the species was first obtained and citations to pages in the book where the species is discussed or referred to. One chapter each is devoted to insects and mites of the following crops: avocado, vinifera grape, Persian walnut, almond, pecan, fig, olive and date. Chapter 14 treats of insects of the oriental persimmon, the pomegranate and the sweet cherry. Chapter 15 deals with rodents, nematodes and snails; Chapter 16 with fumigation; Chapter 17 with spraying and dusting; and Chapter 18 with domestic plant quarantines that pertain to subtropical fruit insects.

The book is rich in illustrations of high quality. The text figures number 377, but the individual illustrations probably are several hundred in number, since in many instances several illustrations are included in a single text figure. The value of the book is greatly enhanced by the footnote references to the principal publications dealing with the topics discussed. The very complete index, comprising 27 pages and having subtropics indicated under principal topics, deserves special mention. For example, under the topic Oil Spray are listed page references to 36 subtopics on oil sprays. The book is substantially and attractively bound. The quality of paper and printing craftsmanship are excellent.

While the book is written primarily for the use of growers of subtropical fruits and persons engaged in entomological work concerned with this type of horticulture, it contains a great deal of information that should be interesting to entomologists in general and even to the general reader. The history of fumigation with deadly hydrogen cyanide gas and the details of the practice of this method of citrus insect control, extensively employed for the past fifty years, is intensely interesting. Equally interesting are the facts of biological control and the methods employed by some fifteen insectaries in California in rearing and releasing annually millions of parasitic and predaceous insects which attack the injurious insects.

RALPH H. SMITH

SPECIAL ARTICLES

AN ESTIMATE OF THE MAXIMUM VALUE FOR THE MOLECULAR WEIGHT OF THE TOBACCO MOSAIC VIRUS PROTEIN

DATA obtained by ultracentrifugal studies reported by Inga-Britta Erikson-Quensel and The Svedberg[1] and by R. W. G. Wyckoff, J. Biscoe and W. M. Stanley[2] indicate that the molecular weight of the infectious unit of tobacco mosaic virus is of the order of 1.7×10^7. Independent values of the particle weight normally may be obtained from diffusion studies, and H. Neurath and A. M. Saum,[3] using a virus preparation supplied by Stanley, found a diffusion constant of 3×10^{-8}. The implied molecular weight is unreasonably large, although by correcting for the shape of the particle,[4] a value of 41 million was obtained.

Curve B, Fig. 1, was obtained from a diffusion study[5] of a virus preparation obtained by the method used by B. M. Duggar at the University of Wisconsin. It will be noted that the curve is skewed, and it is skewed toward the solvent side. The suggestion is that Fick's law is not followed. On the abscissa are plotted the distances from the boundary in 10^{-1} millimeters, and on the ordinate are plotted the displacements of the scale lines in microns. The time for this particular run was 343,000 seconds. An approximate value for the diffusion constant of 4.5×10^{-9} was obtained from these data following the method suggested by Lamm.[6] As this value is considerably lower than the diffusion constant obtained by Neurath and Saum, one would presume that the difference may be attributed in part to an aggregation of the protein particles induced by the heat treatment called for in the Duggar method. Bawden and Pirie[7] also voice the opinion that the heat treatment induces an aggregation. A diffusion constant of 4.6×10^{-7} was obtained from the data presented in curve A of Fig. 1. These data were obtained from a diffusion study of the same protein preparation, indicated above, dispersed in 6 M. urea + .1 M. phosphate buffer at pH 7. The time for this particular run was 58,080 seconds. The diffusion studies were started after the protein had been in the urea solution for 24 hours.

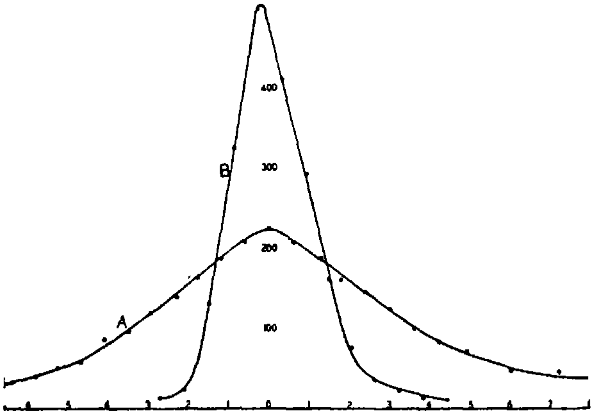

FIG. 1

An increase in diffusion constant from 4.5×10^{-9} to 4.6×10^{-7} is induced by dispersing the virus protein in 6 M. urea. An appreciation of the magnitude of the decrease in particle weight implied in this tremendous increase in diffusion constant is obtained when it is recalled that the relation between the diffusion constant and the radius of a spherical particle given by the Stokes-Einstein equation is

$$kT/6\pi n r = D$$

k = Boltzmann constant
T = Absolute temp.
n = viscosity
r = radius of particle
D = diffusion constant

and that it is assumed that for spherical particles the particle weight varies with the cube of the radius.

A comparison of the biological activity of the virus that had stood in 6 M. urea + .1 M. phosphate buffer and the normal virus in .1 M. phosphate buffer at pH 7 is of particular interest. Data given in Table 1 were obtained by the local lesion method of Holmes.[8] *N. glutinosa* plants were used as test plants; an average of 25 leaves were used for each test. The urea solutions were diluted greatly immediately preceding inoculation.

TABLE 1

Hours in urea	Number of lesions per leaf		
	Concentration of protein in gr/cc		
	3×10^{-4}	3×10^{-5}	3×10^{-6}
0	4.6	1.5	.12
27	5.9	.54	.4
51	7.6	2.2	.12
75	4.1	1.7	.12
96	4.5	2.7	.4
150	1.2		

Inasmuch as the "molar" concentration of the virus in the presence of urea was appreciably greater than in the phosphate buffer alone, it is surprising that there was not a corresponding increase in the number of local lesions produced on the test plants.

Comparative viscosity studies of this same protein in .1 M. phosphate buffer at pH 7 (curve A) and in 6.6 M. urea + .1 M. phosphate buffer at pH 7 (curve B) are presented in Fig. 2. The solution yielding data for curve A contained 4.3 mg protein per cm^3, whereas the solution yielding data for curve B contained 6.3 mg protein per cm^3. The latter curve was obtained after the virus preparation had stood in the urea for 24 hours. Virus preparations prepared after the method of Stanley[9] show a comparable anomaly when dispersed in either water or in phosphate buffer.

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[1] Inga-Britta Erikson-Quensel and The Svedberg, *Jour. Am. Chem. Soc.*, 58: 1863, 1936.

[2] R. W. G. Wyckoff, J. Biscoe and W. M. Stanley, *Jour. Biol. Chem.*, 117: 57, 1937.

[3] In press.

[4] Vernon L. Frampton and H. Neurath, SCIENCE, 87: 468, 1938.

[5] We are greatly indebted to H. Neurath for the privilege of using the Lamm diffusion apparatus he assembled at Cornell University.

[6] O. Lamm, *Zeits. Phys. Chem.*, 143A: 177, 1929.

[7] F. C. Bawden and N. W. Pirie, *Proc. Roy. Soc. London*, 123B: 274, 1937.

[8] F. O. Holmes, *Bot. Gaz.*, 87: 39, 1929.

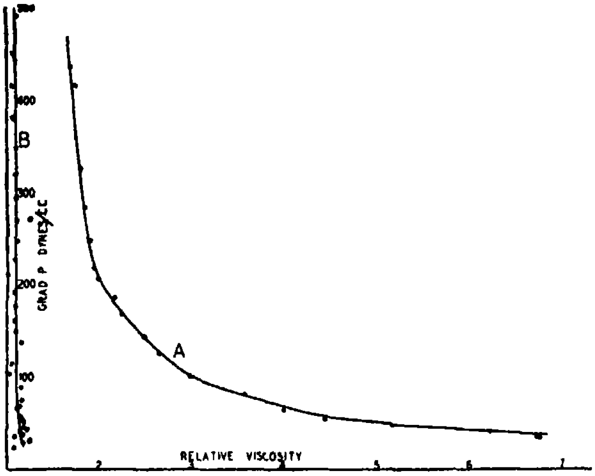

Fig. 2

In view of the anomalous viscosity shown by sols of the virus protein in phosphate buffer and the apparent deviation of the diffusion processes from those demanded by Fick's law, it is doubtful that unambiguous values for the particle weight of the chemically prepared virus protein may be obtained by methods involving diffusion in phosphate buffer. A probably less ambiguous value for the particle weight may be obtained from the data for the diffusion in urea solutions. On the basis of the observations presented in this communication, and recalling that a molecule is the smallest particle which can exist as an independent entity, would one not reason that a maximum value for the molecular weight that may be assigned to the virus protein is of the order of 10^5?

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RELATION BETWEEN THE INCREASE IN OPACITY OF YEAST SUSPENSIONS DURING GLUCOSE METABOLISM AND ASSIMILATION[1]

When washed yeast cells are suspended in glucose-phosphate solutions, the opacity of the suspension, as measured by a photoelectric densitometer, increases with time.[2] The rate of change in opacity has been found to vary with the strain of yeast employed, the age of the culture and the experimental conditions. In a typical experiment with Fleischmann's GM strain of bakers' yeast (obtained 2 days after separation at the factory), the optical density (log opacity) changed from 0.170 to 0.417 within 6 hours after the addition of 5 per cent. glucose to cells previously washed and suspended in M/15 KH_2PO_4 (aerobic conditions, 25° C.). The observed change in optical density with time is entirely referable to the suspension and not to the instrument, since variation in the intensity of the light source or in the "constants" characteristic of the phototubes was eliminated by the type of circuit employed and the procedure used in obtaining the measurements.[3] From a consideration of the theory of densitometry as applied to the type of instrument employed,[4] it was apparent that the observed change in optical density resulted from an increase in cell number and from some progressive change in optical characteristics of the cells or from either of these factors operating alone.

We have found no significant increase in cell number under the experimental conditions employed above. This conclusion is based on 11 experiments on GM yeast and 4 experiments on Strain 4360 cultivated in this laboratory. The cell counts were made with a haemacytometer on at least 4 separate samples taken at various intervals during each experiment; 2,000 to 3,000 cells were counted in each sample. In the experiment on GM yeast cited above, the cell counts were as follows: immediately after adding the glucose, 49,640 cells/c.mm.; after 1 hour in glucose, 52,380; after 3 hours, 50,220; after 5 hours, 52,100; and after 6 hours, 52,350. A difference greater than 6 per cent. was considered significant for these suspensions.

Investigations of the changes which the cells of the GM strain undergo with time after suspension in a glucose solution show (a) that the opacity of the individual cells increases with time (evidence from direct microscopic observations and from photomicrographs); (b) that the dry weight per unit number of cells increases progressively with time, very nearly paralleling the increase in optical density of the suspension; (c) that the increase in weight results from the storage within the cells of substances syn-

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[9] W. M. Stanley, *Jour. Biol. Chem.*, 115: 673, 1936.

[1] Support from the William F. Milton Fund of Harvard University is gratefully acknowledged.

[2] *Cf.* legend to Fig. 2 in T. J. B. Stier, W. Arnold and J. N. Stannard, *Jour. Gen. Physiol.*, 17: 383–392, 1934, where an increase in opacity under similar experimental conditions was reported.

[3] T. J. B. Stier, W. Arnold and J. N. Stannard, *ibid.*, p. 386.

[4] *Cf.* H. Mestre, *Jour. Bact.*, 30: 335, 1935; and L. G. Longsworth, *Jour. Bact.*, 32: 307–328, 1936.

thesized from the glucose (evidence obtained from chemical analyses of glycogen, total carbohydrate and total fat content); (d) that the cell volume, measured by a centrifuge method, increases with time.[5] The optical density of the suspending medium did not change during 6 hours at 25° C. The evidence obtained indicates, therefore, that the increase in optical density of the suspension is primarily due to progressive changes in optical characteristics of the cells and that these changes accompany the formation and storage of anabolic products within the cells.

On the basis of the above results it is proposed that the changes in optical characteristics of yeast cells during assimilation might be used as indicators of anabolic activity. Thus, the rate of increase in optical density of the cell suspension might be conveniently employed as a measure of the "rate of assimilation." A rapid, optical method for use in exploratory experiments dealing with the dynamic aspects of the assimilation process would obviously reduce the total time and effort demanded by a kinetic type of attack on the mechanism of carbohydrate and fat assimilation. The long, laborious chemical methods of analysis would still be employed, but only for each series of check experiments. Our present densitometer can be employed for this purpose within certain limits. It has been sufficiently reliable for the qualitative detection of whether or not assimilation is taking place in a given yeast suspension in which the total number of cells remains constant with time; it also has given a linear relation between the opacity of the suspension and the per cent. increase in dry weight of the cells during the early stages of carbohydrate assimilation (*i.e.,* during about the first 2 hours at 25° C.). We hope to develop a more satisfactory method of measuring specifically the change in cellular opacity in order to follow with greater accuracy the entire course of carbohydrate and fat storage.

Details of the experiments reported in this paper will be published shortly.

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THE USE OF PURIFIED THROMBIN AS AN HEMOSTATIC AGENT[1]

RECENTLY we have described a thrombin preparation which is far more powerful than any previously reported.[2] In a 1 per cent. solution, 1 cc will clot 1 cc of blood within 2 seconds. Animal studies show that such a solution is highly effective when applied locally to check hemorrhage. It has been found to be non-toxic when used to control the oozing of blood from operative surfaces. For this purpose it is applied by means of an atomizer. Under these circumstances a thin film of blood forms almost instantly, and this seals the finer vessels. The larger vessels are controlled by ligature as a preliminary measure.

With the thrombin spray, profuse bleeding from incised liver tissue can be checked completely in 5 seconds or less. Prolonged bleeding from bone is often very troublesome to the surgeon at the time of operation. With the application of thrombin we are able to stop this bleeding within 5 to 10 seconds. This obviates the need of bone wax, which is a foreign body. With the use of thrombin, we have been able to resect portions of brain and to check with ease the hemorrhage which is otherwise so difficult to control.

The same beneficial effects have been obtained in operations on dogs with a prothrombin deficiency which can be produced by chronic chloroform administration.[3] In such dogs, bleeding is very profuse at operation and may be fatal unless thrombin is applied.

The important applications to human surgery and to human bleeders await further study regarding the sterility of the thrombin preparations.

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ISOLATION OF CRYSTALLINE HETEROTRYPSIN FROM BEEF PANCREAS

NORTHROP and Kunitz have prepared from beef pancreas the two crystalline enzymes, trypsin and chymotrypsin.[1] For both of these enzymes, specific substrates have been synthesized in this laboratory. Trypsin was shown to hydrolyze benzoyl arginine amide, while chymotrypsin was found to split benzoyl tyrosyl glycine amide. Another synthetic substrate, benzoyl glycyl lysine amide, was found to be hydrolyzed by crude pancreatic extracts, but not by trypsin or chymotrypsin.[2] Therefore, the hydrolysis of this lysine compound was attributed to an unknown enzyme in the pancreatic extract. This enzyme has been designated heterotrypsin.[3]

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[5] *Cf.* O. W. Richards and T. L. Jahn, *Jour. Bact.,* 26: 385–391, 1933; and L. G. Longsworth, *ibid.,* for discussions of the effect of an increase in cellular opacity and volume during growth by cell division on measurements of population density by the photoelectric method.

[1] Aided by a grant from The John and Mary R. Markle Foundation. Funds for a technical assistant were supplied by the Graduate College, State University of Iowa.

[2] W. H. Seegers, H. P. Smith, E. D. Warner and K. M. Brinkhous, *Jour. Biol. Chem.,* 123: 751, 1938; *ibid.,* 126: 91, 1938.

[3] H. P. Smith, E. D. Warner and K. M. Brinkhous, *Jour. Exp. Med.,* 66: 801, 1937.

[1] M. Kunitz and J. H. Northrop, *Jour. Gen. Physiol.,* 19: 991, 1936.

[2] M. Bergmann and W. F. Ross, *Jour. Am. Chem. Soc.,* 58: 1503, 1936; M. Bergmann, J. S. Fruton and H. Pollok, SCIENCE, 85: 410, 1937.

It has now been observed that heterotrypsin is contained in exudates from bovine pancreas. With the above-mentioned lysine-containing substrate as a guide, the task of isolating heterotrypsin from the pancreatic exudate was undertaken. This was easily accomplished by a process which consists essentially in a 0.4 saturation with ammonium sulfate at pH 7.0. The enzyme was thus obtained in the form of fibrous crystals which exhibited a very high activity towards benzoyl glycyl lysine amide. The crude crystals contained only traces of trypsin and chymotrypsin. A quantitative study of the action of pancreatic exudates on our synthetic substrates showed that the amount of heterotrypsin in the exudates is several times that of trypsin, while chymotrypsin is almost entirely absent.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

METHOD FOR "FIXING ICE CRYSTAL PATTERNS" IN FROZEN PRODUCTS

IN the course of microscopic studies of fruits and vegetables preserved by freezing, considerable difficulty was experienced in using the paraffin method for obtaining sections. Such tissues as ripe strawberry, peach and raspberry or young stems of asparagus, broccoli and spinach are almost without thickened cell walls; and after they are badly ruptured by ice crystals, become very flabby on thawing. It was found almost impossible to maintain the original structure throughout the long process of paraffin embedding.

Sectioning the thawed material with a sliding microtome was equally unsatisfactory.

After considerable experimenting, a method of sectioning the frozen material was developed which was very rapid and satisfactory.

In this case the microtome and all supplies were placed in a freezing room an hour in advance in order to become thoroughly chilled. Temperatures of the room were varied from 0°F. to above freezing, and it was decided that a temperature below 15° F. was uncomfortably cold and caused sections to be too brittle, while that above 25° F. was objectionable because it permitted partial thawing of the material from the warmth of the body. From 18° to 20° F. was decided to be the most suitable temperature for making frozen microtome sections. A refrigerated truck used for hauling frozen products made an ideal sectioning room.

Tissues of most fruits and vegetables were satisfactorily sectioned from ten to thirty microns thick provided the ice crystals were very small. Those frozen with solid carbon dioxide, by the immersion method or other methods producing a very quick freeze, sectioned as smooth as a block of green soft wood; while those containing large ice crystals could not be cut in sections less than thirty microns thick, and then both cell walls and cell contents were often fragmented. Frozen sections were floated in a chilled, killing and fixing fluid as they were cut and placed in very small petri dishes. Formic-acetic-alcohol (acetic acid 5 per cent., formalin 10 per cent., alcohol 70 per cent., water 15 per cent.) was satisfactory for this as it rendered the sections fairly stiff, which prevented sticking together and made handling much easier. Ice crystal patterns in vegetative tissue were very satisfactorily fixed.

For staining unmounted sections more than a dozen single and double stains were used with some degree of success. Best results were obtained with eosin, orange G and basic fuchsin for staining cell contents, and light green, basic fuchsin and methylene blue for cell walls. Due to lack of secondary thickening in cell walls of most of the material used, double staining was of limited value; however, safranin-Delafields haematoxylin was good for gross anatomical study of asparagus tips, and orange G, light green or safranin-light green was excellent for study of starch grains and cell walls of peas, beans and corn.

This method is very rapid, as the writer has, on numerous occasions, made sections and carried them through the process of dehydrating, staining and mounting in balsam, in one-half day. The adaptability of the method depends not so much on the material, nor on the temperature of the cutting room, as on the initial freezing temperature of the product.

In this way ice crystal patterns could be fixed, measured and photographed very accurately, and thereby establish a means of evaluating methods of freezing fruits and vegetables. The writer has made more than one thousand measurements of ice crystals in about a dozen products frozen by eight different methods.

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A NEW APPARATUS AND METHOD FOR TRAINING THE RAT IN AUDITORY DISCRIMINATION PROBLEMS

SEVERAL investigators have reported from time to time considerable difficulty in training lower mammalian forms, particularly the rat, to respond differentially to auditory stimuli. Still greater difficulty has been encountered in the attempts made to train these animals to localize the direction of sounds and to discriminate pitches and loudnesses. Experimentalists are in general agreement that in problems related either to the peripheral or to the central aspects of the auditory modality one of the major problems is the development of a methodology for training the infra-primate subject. Two major difficulties relative to the available procedures in this field of investigation can be found in the literature. First,[1] certain methods require prolonged training periods and so preclude the formulation of any very detailed operative program. Second,[2] other methods of training eventuate in such decidedly abbreviated responses to auditory stimulation that it is difficult, if not upon occasion impossible in the later stages of learning, to determine whether the animal has or has not responded.

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[3] M. Bergmann and J. S. Fruton, *Jour. Biol. Chem.*, 118: 409, 1937.

The apparatus and training procedure described at this time, it is believed, overcomes to a certain degree these difficulties. The apparatus consists of a modified living cage, the floor of which is an electric grid. Located within this cage and resting on the grid is a small platform which may become if need be a second grid. Acclimatization of the animal, in our experiments the rat, is permitted by placing it in the cage some hours before beginning the preliminary training. During this initial training period the animal is given a series of twenty shocks per day and is required to jump upon or down from the secondary grid-platform. Following the acquisition of this shock-escape response, a buzzer or a thousand-cycle tone is presented and is followed by the shock. All animals so far tested learn rapidly within the range of individual differences to escape the shock by making the appropriate shock-avoidance response. Thus in this experimental arrangement only one response can be made, namely, movement away from the present position. The rapid learning of the rat which has thus far been observed permits in terms of the time element the initiation of a more detailed operative program involving a study of cerebral mechanisms in audition.

The modified cage arrangement described above permits numerous modifications. It is believed this apparatus could be enlarged and consequently utilized for larger mammals, such as the cat, the dog and the guinea pig. Certain evidence already available shows the possibility as well as the plausibility of training animals to discriminate between tones on the basis of pitch and loudness differentia. A further modification for the study of auditory localizing behavior is in progress. Obviously, however, the size of the cage floor, the size of the second grid and the construction of the walls of the cage will depend upon the nature of the study as well as upon the size of the animal subject. In this particular arrangement the walls have been constructed of galvanized iron. A screened top with mirror arrangements obviates certain recording difficulties. The use of the solid walls thus makes impossible an alternative wall-clinging response. From one point of view, however, it is suggested that this response itself might be found sufficient for the determination of a statistically reliable response to sound stimuli.

The values of this modified living cage method in training the rat to respond to sound stimuli are numerous. First, the method is sufficiently simple to make unnecessary the cradle arrangements use by Britt[3] and Schlosberg.[4] Second, the experimental arrangement is comparatively close to the normal living conditions of the animal. The artificiality of the Y-maze arrangement[5] in relation to sound stimuli is somewhat obviated. Third, as a corollary of the above, the rapidity with which modifications in behavior occur makes possible the study of certain little understood brain mechanisms in at least one sense modality. Fourth, the response of the animal under the conditions of these arrangements is always clear-cut and observable. Fifth, the use of shock as an incentive seems from several points of view to be superior as a motivating agent over food. Shock can be controlled and measured in more rigorous fashion. Sixth, the possibility of the study of certain other sense modes in relation to cerebral function is suggested by the method of training just outlined.

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[2] W. R. Brogden and E. Culler, Science, 83: 269, 1936.

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SPECIAL ISSUE CONTAINING REPORTS OF THE FIRST RICHMOND MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE AND ASSOCIATED SOCIETIES

SCIENCE

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THE RICHMOND MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE AND ASSOCIATED SOCIETIES

Edited by Dr. F. R. MOULTON
PERMANENT SECRETARY

A TRIUMPH FOR THE SOUTHEASTERN STATES

As hosts for the one hundred and third meeting of the association, the first in Richmond, held from December 27 to 31, inclusive, Virginia and its cooperating neighbor states achieved a notable success. Although there were about 5,000 persons in attendance at the meeting, the misgivings respecting adequate facilities for the scientific sessions and accommodations for individuals all proved unfounded. Indeed, the rooms for the meetings were very satisfactory and won much favorable comment, and not a complaint was heard about housing.

Successful local arrangements did not simply happen. They were the result of careful planning and effective execution by a very competent general planning committee, under the chairmanship of Mr. Lloyd C. Bird, and by special committees on finance, public relations, housing, transportation, registration and information, meeting places, special dinners, entertainment of officials and distinguished guests, publication of program, entertainment, public meetings and visits to plants. These committees gave unsparingly of their time and energy and followed through on every undertaking to its final conclusion. Every one of these committees set a standard of performance that will be difficult to surpass.

The scientists of the Southeast and the South presented a total of 289 papers at the meeting as follows: Virginia, 82; North Carolina, 57; Louisiana, 39; Georgia, 25; Florida, 18; Tennessee, 14; Alabama, 13; South Carolina, 13; Kentucky, 12; West Virginia, 11; and Mississippi, 5.

Richmond lived up to the reputation of the South for hospitality. Not only were many delightful social functions arranged, but there were endless minor acts of courtesy that made visitors feel that they were welcomed as friends. No other part of the country would have thought of supplying the visitors with apples, often offered from filled baskets by attractive young ladies. Neighboring Williamsburg and generally delightful weather offered opportunities for enjoyable excursions. On the last day of the meeting Dr. John Stewart Bryan provided a trip to Williamsburg and luncheon to members of the executive committee and to distinguished members of the association. The teas that were served at the science exhibition were greatly enjoyed by those who participated in them. Evidently the association should establish a general recreation and social center in connection with its registration headquarters and scientific exhibition, with facilities for handling incoming and outgoing mail, telephone calls and telegrams, and at which tea would be served every afternoon. There are other important benefits of a great meeting of scientists besides listening to abbreviated reports of technical investigations.

A FEW STATISTICS

In 1931 the association met at New Orleans, La., and at Nashville, Tenn., in 1927. Statistical comparisons of these most recent meetings in southern cities with the meeting at Richmond are as follows:

Meeting	*Nashville*	*New Orleans*	*Richmond*
Year	1927	1931	1938
Registration	1,662	1,447	2,553
Estimated attendance	2,500	2,750	5,000
Papers read	1,141	1,372	1,706

In addition to 34 registrations by members of the press, the registration, by states and countries, was as follows: Alabama, 20; Arizona, 1; Arkansas, 3; California, 33; Colorado, 7; Connecticut, 52; Delaware, 7; District of Columbia, 179; Florida, 21; Georgia, 37; Illinois, 91; Indiana, 34; Iowa, 28; Kansas, 12; Kentucky, 14; Louisiana, 26; Maine, 18; Maryland, 168; Massachusetts, 130; Michigan, 44; Minnesota, 33; Mississippi, 9; Missouri, 39; Montana, 4; Nebraska, 4; New Hampshire, 16; New Jersey, 80; New York, 345; North Carolina, 117; North Dakota, 2; Ohio, 96; Oklahoma, 8; Oregon, 3; Pennsylvania, 152; Rhode Island, 24; South Carolina, 20; South Dakota, 1; Tennessee, 34; Texas, 22; Utah, 1; Vermont, 7; Virginia, 460 (Richmond, 163); Washington, 1; West Virginia, 32; Wisconsin, 31; outside United States, 53 (Australia, 1; Canada, 39; Canal Zone, 1; China, 1; England, 2; Hawaii, 3; India, 1; New Zealand, 2; Puerto Rico, 3), a total of 2,553. Registration was possible only at the headquarters in connection with the Annual Science Exhibition in the Mosque. By no means all of the members of several of the affiliated societies registered as attending the meeting of the association. The British Association admits to its meetings and principal social functions only those persons who have paid its registration fee of 21 shillings.

Fifteen sections of the association and 38 affiliated and associated societies presented programs at the meeting. The scientific sessions, 219 in number, were held in 54 rooms and laboratories, 44 of which were equipped with projection lanterns that were used in the presentation of 850 papers. Five motion picture projectors were used in 22 programs, and 93 microscopes, with auxiliary lights, were provided for demonstrations by biologists. In addition to the scientific sessions, arrangements were made for 33 breakfasts, luncheons and dinners. The index of the 1,720 persons listed as authors of papers or as delivering addresses occupied 23 pages, double column, of the General Program of 269 pages.

GENERAL SESSIONS

On Tuesday evening, December 27, Dr. George D. Birkhoff, professor of mathematics in Harvard University and dean of the Faculty of Arts and Sciences, delivered his address as retiring president of the association on "Intuition, Reason and Faith in Science." This distinguished contribution to the fundamental bases on which scientific theories ultimately rest was published in the December 30 issue of SCIENCE. Dr. Wesley C. Mitchell, president of the association, presided. The large and excellent auditorium of the Mosque was largely filled with an audience which followed Dr. Birkhoff with close attention. After the address members of the association were the guests of the local committee at an enjoyable reception in the Jefferson Hotel.

On Wednesday evening, the seventeenth annual address under the joint auspices of the association and the Society of the Sigma Xi was delivered by Dr. William F. Durand, emeritus professor of Stanford University, member of the National Advisory Committee for Aeronautics and chairman of the Special Committee on Airship Design and Construction of the U. S. Navy. Dr. George W. Baitsell, professor of biology in Yale University and president of the Society of Sigma Xi, presided. The subject of Dr. Durand's address was "Modern Trends in Air Transport," under which title he delivered a clear and fascinating account of the past progress of aviation, its present trends and the fundamental limitations to which future developments are subject in respect to size of airplanes and the speed and altitude they may attain.

Following the address of Dr. Durand, Dr. David Sarnoff, chairman of the board of directors of the National Broadcasting Company, delivered a stirring address on "Science and Freedom." Large audiences enthusiastically received both addresses.

The fourth annual lecture sponsored by United Chapters of Phi Beta Kappa was delivered on Thursday evening in the auditorium of the Mosque by Dr. Frank Pierrepont Graves, president of the University of the State of New York and New York State Commissioner of Education, on "Is Education a Science?" The presiding officer was Dr. J. Shelton Horsley, surgeon-in-charge of St. Elizabeth's Hospital, Richmond, Va. The lecture of Dr. Graves was especially interesting because of the activities of the Section on Education in exploring the problem of education as a science, as well as because of the rapidly increasing attention scientists are giving to problems of science education.

On Thursday evening Sir Richard Gregory, distinguished British scientist and retiring editor of *Nature*, delivered a warmly received lecture in Grace Covenant Presbyterian Church on "Religion in Science."

On Friday evening there were two general sessions. In the Auditorium of the Mosque Dr. C. Macfie Campbell, director of the Boston Psychopathic Hospital, Boston, Massachusetts, delivered the concluding address of the Symposium on Mental Health on "Human Needs and Social Resources." Dr. Campbell's address was both popular and scholarly and was a fitting conclusion to the fine program of the Section on Medical Sciences. In the Auditorium of the Jefferson Hotel, Dr. Harvey Fletcher, research director in the Bell Laboratories, retiring vice-president of the association and retiring chairman of the Section on Physics, delivered a lecture on "Auditory Patterns," which was supplemented and illustrated by demonstrations of the highest merit both from the scientific and the artistic point of view. All who attended the lecture-demonstration felt they owed much to Dr. Fletcher and his assistants for moving his expensive and highly technical apparatus to Richmond at a great cost in time and labor.

As a special event, on Tuesday afternoon, Dr. Cranston Williams delivered an address on "Dr. Charles H. Herty's Methods of Meeting the Problems of the South," and on Thursday afternoon Dr. William T. Sanger, president of the Medical College of Virginia, Richmond, delivered an address, complimentary to the ladies present in Richmond, on "Virginia Homes and Gardens." This lecture was illustrated by slides in natural color made by Mr. Max Freydeck, Medical College of Virginia.

The final special event for the general public was the exhibition by Dr. William M. Mann, director of the National Zoological Park, Washington, D. C., of motion pictures illustrating his trip to Sumatra, under the auspices of the National Geographic Society, for the purposes of obtaining specimens of wild animals.

SYMPOSIA

With the subdivisions of science into more and more special fields, integrations of the various sciences become increasingly important. Indeed, syntheses of science and explorations of the interrelations between science and society are essential for the progress of civilization. Since the association through its 15 sections and 167 affiliated and associated societies covers nearly all pure and applied science, it offers unparalleled opportunities to promote such integrations through the organization and presentation of symposia which pay little heed to the narrow boundaries of the various special subjects. For the meeting in Richmond 28 symposia were organized, ranging all the way from those presented at a single session to the one on "Mental Health," which consisted of 50 papers besides formal discussions and required three full days for its presentation. The symposia were as follows:

Section on Chemistry (C): "Reaction Rates in Organic Chemistry," 5 papers; "Natural Resins," 4 papers; and "Phenanthrene and Related Compounds," 6 papers.

Section on Geology and Geography (E), Section on Astronomy (D), American Geophysical Union and Geological Society of America: "The Importance of Geophysics to the Study of Continental Borders," 9 papers.

American Society of Zoologists and Genetics Society of America: "Chromosome Structure," 4 papers. American Society of Zoologists: "Color Changes in Animals, Their Significance and Activation," 6 papers; and "Mating Types and Their Interactions in Ciliate Infusoria; Determination, Inheritance and Relation to Sexuality," 6 papers.

American Association of Economic Entomologists, Entomological Society of America and Ecological Society of America: "Insect Populations," 5 papers.

Botanical Society of America: "The Effects of Water-Soluble Growth-Promoting Substances on Plants," 3 papers; "The Structure of Chloroplasts," 3 papers; "The Teaching of Botany." The Physiological Section of the Botanical Society of America, American Society for Horticultural Science and American Society of Plant Physiologists: "Influence of Low Temperature on Plants," 5 papers.

American Society of Plant Physiologists, American Phytopathological Society and Physiological Section of the Botanical Society of America: "The Physiology and Diseases of Cotton," 9 papers. American Society of Plant Physiologists: "The Teaching of Plant Physiology," 5 papers.

American Fern Society: "Ferns of Virginia and Neighboring States," specimens, photographs and slides.

American Society of Naturalists, American Society of Zoologists, Botanical Society of America, Genetics Society of America and the Section on Anthropology (H): "Contributions of the Higher Animals to an Understanding of Human Biology," 3 papers.

Limnological Society of America: "Some Leading Problems of Limnology with Special Reference to Lakes," 5 papers.

Section on Psychology (I): "Research in Audition: The Next Step," 5 papers.

Section on Social and Economic Sciences (K): "Significance of the Pareto Distribution," 3 papers.

Section on Historical and Philological Sciences (L), Section on Zoological Sciences (F) and Section on Botanical Sciences (G): "Centenary of the Cell Theory," 7 papers.

Section on Medical Sciences (N), American Psychiatric Association, U. S. Public Health Service, the Mental Hospital Survey Committee and the National Committee for Mental Health: "Mental Health," 50 papers. Subsection on Pharmacy of the Section on Medical Sciences (N): "Glycols," 5 papers.

Section on Agriculture (O) and Section on Social and Economic Sciences (K): "Land Use," 3 papers.

Section on Education (Q): "Economic Effects on Education," 4 papers; "Mental Hygiene and Education," 2 papers and round table; "Problems of Interpretation of Educational Research," 7 papers; "Problems of Reading," 4 papers; "New Developments in Education," 5 papers.

WALTER B. CANNON, PRESIDENT-ELECT

(*By Esmond R. Long*)

Dr. Walter Bradford Cannon, George Higginson professor of physiology at Harvard University, was unanimously elected president of the association at the meeting of the council on December 30. He is the first physiologist and the sixth representative from the medico-biological sciences to fill this position. His predecessors have been Minot, Welch, Flexner, McMurrich and Abel.

Dr. Cannon was born at Prairie du Chien, Wisconsin, on October 19, 1871. He received the degree of bachelor of arts from Harvard University in 1896, and graduated in medicine in 1900. Immediately thereafter he entered the department of physiology as instructor, where he displayed such ability that six years later he was appointed professor and head of the department. With brief leaves of absence his entire academic life has been at Harvard University. In 1929–30 he was exchange professor at the Sorbonne and Ecole de Médecine in Paris and in 1935 visiting professor at the Peiping Union Medical College.

For nearly forty years Dr. Cannon has been one of America's outstanding physiologists. His earliest research was in the field of gastro-enterology, centering on the motor activities of the alimentary canal; out of this came his monograph on "The Mechanical Factors of Digestion" in 1911. The interest stimulated during these inquiries led directly to the long series of investigations for which Dr. Cannon is perhaps best known, those dealing with hunger, pain, strong emotional states and the associated physiological mechanisms. He published his well-known work on "Bodily Changes in Pain, Hunger, Fear and Rage," one of the classics of modern physiology, in 1915, characteristically dedicating it to the ten associates with whom he had conducted the fundamental investigations. His central theme was the release of energy in times of need and stress through mechanisms involving the adrenal glands, the sympathetic nervous system and the regulatory apparatus for the metabolism of sugar. The concepts involved, bridging physiology and psychology, were unique, and in the early years strongly contested by some physiologists. Cannon met all opposition with temperance and continued industry in the laboratory, and in the succeeding years steadily overcame the objections raised. The second edition appeared in 1929, with his major principles accepted.

A third book, almost as well known, was "Traumatic Shock," published in 1923 and based in large part on Cannon's observations in 1917–18 as a medical officer with the American and British Expeditionary Forces. Other works, some purely technical and others semi-popular, were "A Laboratory Course in Physiology" (1910), "The Wisdom of the Body" (1923), "Digestion and Health" (1936) and "Autonomic Neuro-effector Systems" (with Rosenblueth, 1937).

As an educator he has been eminent. From his first years after graduation he has promoted effective medical education. His distinction as a scientist has been widely recognized and marked by many honors. He was Croonian lecturer of the Royal Society in London in 1918, Linacre lecturer at Cambridge University in 1930, Herter lecturer in New York in 1932 and Kober lecturer for the Association of American Physicians in 1934—to mention but a few. He has received honorary doctorates from Yale University, Wittenberg College, Boston University and the Universities of Liège, Strasbourg and Paris, as well as from his alma mater, Harvard University.

Dr. Cannon is to-day no less active in the laboratory than at the beginning of his scientific career. In the intervening years, however, he has given continual service to the scientific organizations with which he has been connected, which have in turn elected him to positions of responsibility. Among other offices he was president of the American Physiological Society in 1914 and a fellow since 1906 of the American Association for the Advancement of Science. He has been a member of the National Academy of Sciences and National Research Council for many years, and of the important policy committee of the latter organization, as well as chairman of one of the council's most effective committees.

During the years of this activity he has made the advancement of knowledge through unfettered research a primary interest. At a time of world conflict in state systems, involving fundamental disagreement over the right of politically constituted authority to control education and investigation, Dr. Cannon's election brings to the presidency of the association not only a wise administrator, but a champion of intellectual liberty and the freedom of research.

THE ASSOCIATION PRIZE AWARD

Each year the association awards a prize of $1,000, provided by an anonymous friend, for an outstanding contribution to science presented at its annual meeting. The committee on award, consisting of Howard A. Meyerhoff, *chairman* (geologist), Dr. F. C. Bishopp (zoologist), Dr. E. A. Culler (psychologist), Dr. Farrington Daniels (chemist) and Dr. William J. Robbins (botanist), unanimously recommended the awarding of the prize for this year to Dr. Norman R. F. Maier, assistant professor of psychology in the University of Michigan, for his paper, illustrated by motion pictures, on "Experimentally Produced Neurotic Behavior in the Rat," which was presented before the Section on Psychology on Tuesday morning, December 27.

In presenting the award to Dr. Maier, the committee fulfilled the hope of the anonymous donor of the prize that it might be bestowed upon one of the younger scientists, not only as a reward but as a stimulus for further work, because Dr. Maier is only 38 years of age. He was born in a village in Michigan, Sebewaing, on November 27, 1900. He took his A.B. degree in the University of Michigan in 1923, majoring in the physical sciences. After teaching in a high school for a year, he returned to the university and took the M.A. degree in 1925, majoring in philosophy and psychology. He then spent a year in the University of Berlin, which at that time, as the center of the Gestalt Movement, was attracting the attention of psychologists in all parts of the world. He returned to Ann Arbor and took his doctor's degree in 1928. He then received a National Research Council Fellowship during 1929 and 1930 for study with Professor K. S. Lashley at the University of Chicago, after which he became a member of the staff of the department of psychology of the University of Michigan.

Dr. Maier's investigations were in the general field of nervous disorders that are not accompanied by any discoverable physical cause. In human beings these mental diseases are among the most baffling and serious. In referring to Dr. Maier's experiments, the committee on award stated: "He has produced in rats behavior, the neurotic character of which seems to the committee, and to the critical audience which heard his paper, to be beyond doubt. This behavior was produced under conditions so controlled that cause and effect can be scientifically analyzed. The committee does not feel that the author's analysis of the phenomena is complete, nor does it believe that the small number of rats in which neurotic behavior was experimentally induced is sufficient for generalization or sweeping conclusions, and it gives credit to Dr. Maier for the conservatism he exhibited and for the scrupulous avoidance of applying his discoveries prematurely to the field in which they ultimately will be vastly significant—namely, neurotic behavior in human beings."

SOME RESOLUTIONS BY THE COUNCIL

On December 27, the council unanimously passed the following resolution on the life, work and death of Dr. Earl B. McKinley:

> In the death of Earl Baldwin McKinley science in America suffered an irreparable loss. When on July 29 the Hawaii Clipper disappeared in the China Sea, it brought to a tragic and untimely end the life of this able and devoted worker, who had rendered signal services in his own country and in distant lands to the advancement of science and to the conquest of disease.
>
> Trained in arts and medicine at the University of Michigan by distinguished teachers and investigators, McKinley was drafted into the faculty of the university even before he had received the medical degree. Rapidly new opportunities offered themselves to him. Research in the tropics of Orient and Occident made him familiar at first hand with the great plagues of man. A keen observer and able interpreter, he promptly won recognition and support for his research projects. With breadth of vision granted only to the few, he sensed intuitively the significant lines of attack on great problems in bacteriology, tropical medicine and public health.
>
> While he gave distinguished services to several universities in this country, he spent a large part of a short but eventful life in the tropics; and only a year ago returned from a sabbatical year devoted to experimental work on leprosy. His last great venture sought to determine the influence of upper air currents in the transportation and dispersal of disease germs. Suddenly with the epochmaking flight westward nearly completed, and in company with another distinguished scientist and member of the American Association for the Advancement of Science, Fred C. Meier, some unknown disaster closed the record. In sight of success he went down to glorious defeat in the great struggle of the human race for freedom from the bondage of disease.
>
> A loyal friend, a genial and vigorous fighter for high ideals, never turned from his purpose by narrow criticism, animated by the constant desire to make the world he knew a better place to live in, McKinley left his mark on many undertakings in science, education and social advancement. The Executive Committee of the American Association for the Advancement of Science, to the work of which he had unselfishly and generously devoted much time and energy, wishes through this tribute to bear testimony to his services for the cause of science and for the welfare of man. All his fellow workers wish to join also in expressing to his family heartfelt sympathy and condolence.

On December 29, the council unanimously adopted the following minute:

> The American Association for the Advancement of Science at its annual meeting in Richmond places on record its appreciation of the cooperation of the Smithsonian Institution and of its distinguished secretaries, the late Charles D. Walcott and the present secretary, Dr. C. G. Abbot. The Smithsonian Institution has since 1907 provided rooms in its building for the headquarters of the association, free of all charge for rent or incidental expenses, and in December, 1928, increased the space to meet the growing needs of the association.
>
> The association may look forward to a building of its own which might provide headquarters also for the national scientific societies affiliated with it; but this will require large funds. In the meanwhile the association is most fortunate in its present location and address. The Smithsonian Institution is a national and international foundation, unique in its origin, its control and its history. On its seal its objects are stated in the classic words: "For the increase and diffusion of knowledge among men." The objects of the American Association for the Advancement of Science are the same; these great organizations can to advantage work together for their attainment.

On December 30, the council unanimously passed the following resolution:

> RESOLVED: That the council, having accepted on October 22, 1938, the offer of J. McKeen Cattell and Josephine Owen Cattell to sell and transfer to the American Association for the Advancement of Science the journals SCIENCE and *The Scientific Monthly*, and having directed the executive committee to complete the details of the purchase and transfer, hereby approves and ratifies the action of the president and permanent secretary in executing on December 12, 1938, by direction of the executive committee, the contract on behalf of the American Association for the Advancement of Science.
>
> The council again expresses to Dr. Cattell and Mrs. Cattell its appreciation of the work they have carried on for many years in editing and publishing the journals, and for transferring them to the American Association for the Advancement of Science under most generous terms.

On Friday, December 30, the council unanimously passed a resolution of appreciation to the citizens of Virginia which, in part, is as follows:

> RESOLVED: That the American Association for the Advancement of Science and its affiliated societies express their deep appreciation to the citizens of Virginia for their splendid cooperation in connection with the 103rd meeting of the association, and the first Virginia meeting, which was held in Richmond from December 27 to 31, 1938. At this meeting about 220 scientific sessions were held, before which about 1,700 papers were presented. In addition to 15 sections of the association, there were 38 associated societies, the total attendance being about 5,000.

PRESS SERVICE

Although the science writers representing the daily press for more than a decade have sent out excellent reports of the meetings of the association, their work at Richmond reached a new high level. This happy result was due in part to the fact that the authors of the scientific papers sent in copies or abstracts of 590 of them out of a total of 1,706 on the programs. The previous high mark, reached last year, was a total of 377 advance contributions out of a total of 1,681 papers on the programs. This year 112 papers and abstracts were mimeographed and distributed to representatives of the press, some of them as much as 10 days before the meeting. Last year 67 papers and abstracts were mimeographed.

Another important reason for the successful publicity of the meeting was the press service organized by the local committee on public relations, under the chairmanship of Dr. Sidney S. Negus. For weeks a stream of excellent publicity went out from this committee, and the facilities provided for representatives of the press during the meeting were unexcelled. More than half a million words were sent out by mail an wire by representatives of the Associated Press, the United Press, the International News Service and Science Service and the 21 daily papers which had special correspondents in Richmond to report the meeting. Columns appeared daily in newspapers from coast to coast, often on the first pages of leading papers. The meeting was the "big news" of the week, as Mr. Thomas R. Henry, president of the National Association of Science Writers, expressed it. Not only was the country informed about the progress of science by the press, but the scientists themselves, even those who attended the meeting, learned much about science and their own activities from the daily papers. In commenting on the accounts of the meeting sent out by the science writers, Sir Richard Gregory said that nothing comparable to them in quantity or in quality was known in Great Britain.

RADIO PROGRAMS

During the meeting at Richmond a total of 34 broadcasts were delivered by the scientists, several of them over national networks. The largest number of broadcasts at any previous meeting of the association was 16 at Indianapolis last year. The success in arranging broadcasts at Richmond was largely due to Professor George W. Jeffers, who carried the entire responsibility of arranging programs and of getting those who were to deliver broadcasts at the right broadcasting stations at the scheduled times.

The bright spot in the radio program was the broadcast of Sir Richard Gregory over the blue network of the National Broadcasting Company on "Religion in

Science." Other speakers were: Dr. Leroy Allen, Dr. E. R. Becker, Mr. Rudiger Bilden, Dr. A. F. Blakeslee, Dr. Eliz. Deichmann, Dr. C. L. Fenton, Mr. A. R. Gopal-ayengar, Dr. Lawrence Irving, Dr. G. W. Jeffers, Mr. A. S. Klemetsmo, Dr. C. C. Little, Dr. William M. Mann, Professor A. B. Massey, Dr. Medsger, Dr. H. A. Meyerhoff, Dr. W. R. Miles, Dr. F. R. Moulton, Mr. F. P. Mulgannon, Mr. Wilbur Nelson, Dr. E. Lawrence Palmer, Dr. G. M. Parker, Mr. C. W. Quaintance, Miss E. E. Shaw, Dr. C. C. Speidel.

THE ANNUAL SCIENCE EXHIBITION

There were 47 exhibits in the Annual Science Exhibition, which was organized by Mr. Owen Cattell. Of these exhibits, 4 were by individual scientists in their special fields, 13 by scientific institutions and organizations, 10 by publishers of scientific books and 17 by manufacturers of scientific materials and equipments. The space in the Mosque occupied by the exhibition and the registration desks of the association was in every way satisfactory. A room adjacent to the exhibition in which scientific motion pictures were almost continually exhibited was an added attraction. Since much of scientific importance can be clearly presented by motion pictures that can not be readily described by words, it is obvious that this means of instructing and entertaining the public should be steadily expanded. The science exhibition must become an increasingly important feature of the meetings of the association.

The scientists who put on exhibits of their processes and products were: Dr. Albert F. Blakeslee, Carnegie Institution of Washington; Dr. Charles T. Knipp, University of Illinois; Dr. Samuel A. Mitchell and the University of Virginia; and Dr. Louis B. Wilson, the Mayo Foundation. The scientific institutions and organizations which presented exhibits were: *Biological Abstracts;* Boyce Thompson Institute for Plant Research; U. S. Bureau of Animal Industry; Carnegie Institution of Washington, Cold Spring Harbor; Carnegie Institution of Washington, Department of Terrestrial Magnetism; Duke University in cooperation with the Virginia Agricultural Experiment Station; U. S. Forest Service; Institutum Divi Thomae, Cincinnati; Museum of Science and Industry, New York; National Bureau of Standards; U. S. Soil Conservation Service; American Association for the Advancement of Science. The publishers having exhibits were: Blakiston's Sons and Company; The Macmillan Company; McGraw-Hill Book Company; the C. V. Mosby Company; Prentice-Hall, Incorporated; W. B. Saunders Company; The Science Press; University Presses; John Wiley and Sons, Incorporated; and The Williams and Wilkins Company. The commercial exhibitors were: American Instrument Company; American Tobacco Company; Bakelite Corporation; Bausch and Lomb Optical Company; Clay-Adams Company; Distillation Products, Incorporated; Eastman Kodak Company; Ford Motor Company; The General Biological Supply House, Incorporated; Gradwohl School of Laboratory Technique, St. Louis; Leeds and Northrup Company; E. Leitz, Incorporated; The Linguaphone Institute; Merck and Company; Phipps and Bird, Incorporated; Radio Corporation of America; Spencer Lens Company; and Superior Tube Company.

THE SECRETARIES' CONFERENCE

(*From report by Ernest Carroll Faust*)

At the annual Secretaries' Conference, held on December 30 under the chairmanship of Dr. Otis W. Caldwell, a memorandum on cooperation between different sections of the association by Dr. Neil E. Gordon, secretary of the Section on Chemistry, was presented and discussed. The note struck in Dr. Gordon's memorandum became one of the principal topics of interest in the general discussion which followed on the problem of organizing programs for the sections and the associated societies.

In the call for the conference sent out by Dr. Faust, it was suggested that the secretaries might discuss (a) their policies in choosing papers, (b) the method of organizing joint sessions and symposia, and (c) demonstration meetings. A spirited and highly beneficial discussion of these and related topics was participated in by Drs. E. P. Hutchinson (Social and Economic Sciences), M. F. Morgan (Agriculture), Percival M. Symonds (Education), J. T. Buchholz (Botany), Malcolm H. Soule (Medical Sciences), Wilton M. Krogman (Anthropology), George F. Baitsell (Zoology), J. McKeen Cattell (Executive Committee), Esmond R. Long (Executive Committee), J. S. Karling (Torrey Botanical Club), E. W. Lindstrom (Genetics Society of America), C. W. Quaintance (American Nature Study Society), Charles F. Brooks (American Meteorological Society), and Oliver R. McCoy (American Society of Parasitologists). After the close of the discussions the 28 persons present attended a complimentary dinner given by the association to the secretaries.

SCIENTIFIC SESSIONS

SECTION ON MATHEMATICS (A) AND ASSOCIATED SOCIETIES

(*From report by E. R. Hedrick*)

Of special interest to members of Section A was the retiring presidential address on Tuesday evening by Dr. George D. Birkhoff, the retiring president of the association. His discussion of the subject, "Intuition, Reason and Faith in Science," was based upon the classical work done in mathematics, on the logical structure of this field, chiefly during the present century. He showed how the same ideals can be applied to all branches of science. Since it has been fifteen years since a mathematician has occupied the presidency of the association and since Dr. Birkhoff is an outstanding leader in mathematical work, this address, though technically not a session of Section A, deserves particular emphasis in any report of the mathematical work presented at Richmond.

It is equally significant that other sessions of Section A were held in conjunction with Section E (Geology and Geography) and with Section L (Historical and Philological Sciences). Recent efforts toward cooperation with other sciences and toward emphasis upon relations of mathematics with other fields are exemplified by these sessions.

On Wednesday morning, W. D. Cairns addressed Section A as its retiring chairman and retiring vice-president of the association, on the topic, "Seismology from a Mathematical Point of View." Participating in this session were not only the American Mathematical Society and the Mathematical Association of America, but also Section E (Geology and Geography). J. R. Kline, the chairman of Section A, presided. The audience was deeply impressed by the scholarly presentation of the applications of mathematics to a field not commonly conceived as one to which mathematics contributes vitally.

Also, on Wednesday morning a far different audience, again comprising many persons from other fields than mathematics, listened to the address of R. C. Archibald, retiring chairman of the Section on Historical and Philological Sciences (L) and vice-president of the association. His topic was "Mathematicians, and Poetry and Drama." This session was held in conjunction with the Mathematical Association of America, the American Mathematical Society and Section L. The address, which was historical in character, brought out in charming fashion, and with evidence of deep research, many details of interest in the lives of mathematicians of note, with special reference to poetry and drama written by or about these men.

Other sessions of the Mathematical Society and the Mathematical Association were held at Williamsburg, in the historic setting of the College of William and Mary. These meetings will be reported in the official journals of those organizations.

The new officers nominated for Section A were Marston Morse for chairman of the section (and vice-president of the association), and W. M. Whyburn as an (elective) member of the section committee of Section A for a period of four years.

SECTION ON PHYSICS (B) AND THE AMERICAN METEOROLOGICAL SOCIETY

(*From report of Robert G. Stone*)

The Section on Physics (B) held only one session, the one on Friday evening at which the retiring chairman of the section and vice-president of the association delivered his vice-presidential address on "Auditory Patterns" (see report of General Sessions). The American Physical Society and the American Association of Physics Teachers, which normally meet with the association, met this year at the National Bureau of Standards in Washington. Lyman J. Briggs delivered an address as retiring president of the American Physical Society on "The National Standards of Measurements." The address of the retiring president of the American Association of Physics Teachers, P. W. Bridgman, was on "Society and the Intelligent Physicist." The technical program consisted of 75 papers from many branches of physics.

The American Meteorological Society held its twentieth annual meeting in three sessions, before which 14 papers were presented. The presidential address of Robert E. Horton was on "What Can We Do about the Weather?," two papers were on the future developments of meteorological methods and services, a group of papers considered the scientific aspects of the New England hurricane in September, and the remainder were devoted to a variety of subjects, such as practical applications of meteorology and climatology to aviation, public health, hydrology and weather forecasting. F. W. Reichelderfer, recently appointed acting chief of the U. S. Weather Bureau, was cordially greeted and in response paid a tribute to his predecessor, the late Dr. W. R. Gregg. C. F. Brooks was elected secretary of the society and L. T. Samuels treasurer.

SECTION ON CHEMISTRY (C)

(*From report by Neil E. Gordon*)

On Tuesday morning the Section on Chemistry began its program with a symposium, consisting of 5 papers, on "Reaction Rates in Organic Chemistry." Farrington Daniels, retiring chairman of the section and vice-president of the association, gave the first paper, pointing out how physical and organic chemistry can and should be correlated, translating the ideas of one into the other. He also explained how to examine especially the field of chemical kinetics in order to determine what is of practical value for organic chemistry. He showed how many types of chemical and physical techniques are used, or may be used, for following the course of a reaction, such as absorption of light, change of pressure, electrical conductivity, use of isotopic and radio-active tracers and the extension of infra-red absorption spectra.

F. O. Rice gave a brief history of the free radicals and then described the new type of technique that has been developed to determine the half-life period of the free radical.

Everett S. Wallis emphasized the now well-established fact that the factor which in reality determines whether a molecule can undergo a chemical reaction (molecular rearrangement) is the amount of internal energy which it possesses. He contends, therefore, that the organic chemist might do well to rely less on the configuration of the organic molecule and obtain more data on reaction rates, effect of solvent, temperature, etc. He believes that from these data a truer picture of the mechanism of any molecular rearrangement can be obtained.

Gustav Egloff's paper on "Reactions of Hydrocarbons" was presented by Vasili Komarewsky, of the Universal Oil Products Company.

Edward Mack, Jr., gave the closing paper of the symposium, centering interest on a consideration of the reactivity of organic molecules as a function of their structure, fixing attention upon the question of bond strength and certain geometrical features of structure. He used carefully prepared models to illustrate certain points of his lecture.

On Tuesday afternoon, the symposium on "Natural Resins" was presented by J. N. Borglin, of the Hercules Powder Company; Wm. Howlett Gardner, of the Polytechnic Institute of Brooklyn, and S. Palkin, of the U. S. Department of Agriculture. Many of those present were pleasantly surprised by the unique methods which the speakers had used to attack their problems and the thoroughness with which they had done their work.

Following this symposium, there was a paper presented by Cranston Williams on "Dr. Herty's Method of Approaching Problems in the South." He gave a very clear picture of the life-work of Dr. Herty, especially of his work in the South, and said in closing, "Superlatives are always dangerous, but I believe the record shows Dr. Herty contributed the greatest service to the South of any person in his generation."

The symposium on Wednesday morning on "Phenanthrene and Related Compounds" had for its chairman E. Emmet Reid. The first paper was presented by Harry Sobotka on the "Physiological Chemistry of Bile Acids." He discussed the increasing number of individual bile acids which have been isolated from the bile of various animals in recent years and showed how the chemical interrelations of these acids serve as a guide to the understanding of their possible genetic relationships.

Walter A. Jacobs gave in great detail "The Chemistry of the Cardiac Glycosides," showing how there are a number of substances occurring in certain plants which he has found to possess a common characteristic action on the heart. Among these substances are digitalis and certain tropical arrow poisons.

Lyndon F. Small and Erich Mosettig presented some of the unique work which is being done at the University of Virginia. Dr. Small emphasized the "Reactions of the Alkaloids Related to Phenanthrene," while Dr. Mosettig's paper gave the recent "Advances in Synthetic Phenanthrene Chemistry." Everett S. Wallis, presenting the closing paper of the symposium, gave the preparation and also a proof of the structure of a new isomer of cholesterol, designating it as i-cholesterol.

On Tuesday evening a dinner was given by the section in honor of its retiring chairman, Farrington Daniels. The speakers at the dinner, in addition to Dr. Daniels, were Harold C. Urey, chairman of the section, and J. C. Forbes, chairman of the Richmond American Chemical Society Local Section.

The business meeting of the section committee held on Tuesday had for its main objective the planning of its meetings for the coming year. As a part of the Milwaukee meeting, from June 20 to 22, the committee formally accepted the invitation of the American Chemical Society Physical Chemistry Division to attend the symposium on "Kinetics," which will be held at that time at Madison, Wisconsin.

The section committee decided to continue the summer research conference at Gibson Island. The topics suggested for the symposia are: (1) Synthetic Resins; (2) Vitamins; (3) Chlorophyll; (4) Relation of Structure to Physiological Action, and (5) Catalysis. These symposia are planned to begin on July 10, and each symposium will be continued for a period of five days —Monday to Friday.

SECTION ON ASTRONOMY (D) AND ASSOCIATED SOCIETIES

(*From reports by H. T. Stetson and Lincoln La Paz*)

The widening contact of astronomy with the allied earth sciences is shown by the joint session of the section with the Section on Geology and Geography, the American Geophysical Union and the Geological Society of America for a symposium on "The Importance of Geophysics to the Study of Continental Borders." Knowledge of the deep-seated crustal structure in coastal areas depends upon both gravitational and seismic data. The possibility that precise astronomical measurements may contribute to the ultimate solution of problems of this nature was discussed, especially in connection with small variations in geographical coordinates that hint of tidal origin. The questions raised at this symposium were most timely in view of the near approach of the Seventh Assembly of the International Union of Geodesy and Geophysics, which convenes in Washington next September.

Regular sessions for the presentation of papers in Section D were held on Wednesday morning and afternoon, R. Meldrum Stewart, chairman of the section, presiding. The principal feature on Wednesday morning was the address of the retiring chairman of the section and vice-president of the association, Philip

Fox, who spoke on "Astronomers and Their Tools," tracing the development of astronomical instruments from early times to the present plans for the 200-inch telescope on Mount Palomar.

Among the more significant papers were those presented by S. A. Mitchell and other members of the staff of the Leander McCormick Observatory. The wealth of material gathered from this observatory furnished data for important contributions not only concerning the distribution of the 1,350 McCormick parallaxes, but also relative to the derivation of the visual, photo-visual and absolute magnitudes of the stars in question.

Problems of fundamental astronomy, such as new determinations of the mass of Venus and the moon from observations of the sun, were presented by H. R. Morgan and F. P. Scott, of the Naval Observatory. The sunspot cycle was discussed in a contribution by C. N. Anderson, of the Bell Telephone Laboratories.

A dinner of the section was held on the evening of December 27, at which Dr. Mitchell invited astronomers attending the meetings to visit the observatory at the University of Virginia. The average attendance at the section meetings was over 40. C. A. Chant, of the University of Toronto, was elected chairman of the section for 1939.

The sixth annual meeting of the Society for Research on Meteorites (Lincoln La Paz, reporting) was held on December 29 and 30. The 25 papers presented were the largest number in the history of the society, and the diversity of the fields represented—astronomy, geology, geophysics, metallurgy, mineralogy, mathematics, physics—emphasized most strikingly the numerous points of contact which meteoritics has with other sciences. The outstanding feature of the meeting was the joint session on Thursday morning with the Section on Geology and Geography on "Meteorites and Meteorite Impacts" and "The Carolina Bays." In the first of these discussions papers were presented by Gerhard Derge, H. H. Nininger, Lincoln La Paz, Clyde Fisher and Hans Lundberg (see report of Section E); the papers in the second were by William F. Prouty, Frank A. Milton, C. Wythe Cooke and Watson H. Moore.

There were two other sessions at which 11 papers were read on a wide variety of subjects by Joseph Kaplan (2), Lincoln La Paz (3), H. H. Nininger (2), John Davis Buddhue, Addie D. Nininger, Betty Jane Thompson and David M. Young, and 3 papers were read by title.

SECTION ON GEOLOGY AND GEOGRAPHY (E) AND ASSOCIATED SOCIETIES

(From report by Howard A. Meyerhoff)

The Section on Geology and Geography (E) met jointly with the Geological Society of America in all its sessions, and in certain of them it combined forces with other sections and societies. Starting its meetings at 9:00 A. M. on Tuesday, December 27, the section remained in continuous session until the evening of December 29. Although several of the 65 papers on the final program were only indirectly concerned with the geology and geography of the Atlantic Slope, the features and problems of the Appalachians, the Piedmont, the Coastal Plain and the Continental Shelf served as the dominant theme, unifying each and all the sessions to an extraordinary degree.

The vice-president and chairman of the section, Walter H. Bucher, presided at the opening meeting, which was held jointly with the Carolina Geological Society. The geology of the coastal plain was the subject for discussion, and the 12 papers dealt with a variety of aspects, including groundwater, stratigraphy, geophysical studies, earthquake problems, beach erosion and economic geology. The concluding papers, stressing features of the continental shelf and geophysical studies of the older rocks on which the coastal plain sediments rest, provided an appropriate introduction to the afternoon symposium on "The Importance of Geophysics to the Study of Continental Borders."

Arranged by the American Geophysical Union at the invitation of Section E, this session also involved the cooperation of the Section on Astronomy (D). Opening with a clarifying exposition of the coordinate functions of geology and geophysics, the symposium thoroughly explored the geologic facts and probabilities which recent geophysical research has disclosed regarding the history, evolution and structure of the continental margins. Shocked by news of the death, on December 24, of Dr. A. C. Veatch, the audience heard the paper prepared by him and Lieutenant Paul A. Smith with a keen appreciation of his genius, somewhat skeptical perhaps regarding the suggestion that the water level in the oceans may have been temporarily lowered as much as 12,000 feet in comparatively recent time, but thoroughly perplexed about the apparent subaerial dissection of the Atlantic border of North America, as revealed in the charts prepared by Dr. Veatch and Lieutenant Smith. The fate and present configuration of the ancient landmass of Appalachia were explored by several speakers, and the facts revealed by analogous geophysical studies along the Pacific Coast were discussed in a paper by Perry Byerly. Following a penetrating analysis of the time problem in obtaining highly accurate measurements of relative continental positions and structures, W. T. Thom summarized the accomplishments of geophysical-geological studies and ventured to predict the results which may be obtained in future research, now that the technical difficulties have been appreciated and partly overcome.

On Wednesday morning the geologists met jointly with the Section on Mathematics (A) to hear the illuminating and pertinent address of W. D. Cairns, retiring chairman of Section A, on "Seismology from the Mathematical Point of View." Fully alive to the dependence of seismological and geophysical studies on mathematics, the membership of Section E was especially appreciative of Dr. Cairns's application of his specialty to one of the earth sciences.

In a session dedicated to the memory of William Barton Rogers, the section obtained a wholesome respect for the mental energy and perspicacity of Virginia's pioneer state geologist from papers read by John Stewart Bryan, Joseph K. Roberts and Arthur Bevan. In the concluding session of the morning, Kirtley F. Mather gave a penetrating critique of modern theories of earth origin in the light of earth structures and their implications, in his retiring vice-presidential address on "Earth Structures and Earth Origins."

Wednesday afternoon, with H. W. Straley III in the chair, another joint session with the Carolina Geological Society was held to review the geology of the Piedmont and Southern Appalachians. Despite the length of the program, which contained 17 papers, an interested audience remained until the meeting ended at 6:45 P. M., while the several speakers filled in a broad canvas, involving fundamentals of pre-Cambrian igneous, metamorphic, structural and economic geology, together with new facts and problems of Paleozoic and Triassic stratigraphy, structure and sedimentation.

H. H. Nininger, president of the Society for Research on Meteorites, presided when that organization met jointly with Section E on Thursday morning. Despite the chairman's withdrawal of his own paper and the voluntary postponement of Dr. Monroe's paper, the morning was not long enough for the interesting papers and vigorous discussion. Gerhard Derge's revelation of the analogies between the structures of the metallic meteorites and certain alloys of the metals, and the significance of these analogies in interpreting meteorite origin; Lincoln La Paz's analytical study of meteorite distribution; and Hans Lundberg's exposition of geophysical research on the site of the Meteor Crater in Arizona were especially illuminating in a program of excellent papers. The joint session ended with a consideration of the Carolina "Bays" and their origin, but the profession seems no nearer a solution to this moot question than it has been at any time; for after the audience gained the conviction that William F. Prouty and his associates had virtually demonstrated their meteoritic origin, C. Wythe Cooke proposed a new non-meteoritic explanation which, in the absence of actual meteorite material, must be given careful study.

The concluding session on Thursday afternoon was concerned with the geology and geomorphology of the central and southern Atlantic states. Climate, soils, soil erosion, the mineral industry and population were among the subjects to receive general treatment; the growth of Durham, North Carolina, as an industrial center, and Hampton Roads as a shipping center made excellent subjects for detailed treatment. In the geomorphic category, coastal terraces, planes of marine erosion and the problem of Appalachian drainage and its course across the structures of the Appalachian Highlands were dealt with in specific papers. Only once did the audience digress from the main theme of the meeting—to hear Rupert B. Vance discuss with humor and keen insight "The Geography of Distinction," and even in this enjoyable paper the Southeastern States featured conspicuously. It was 6:45 P. M. before the chairman, Dr. Straley, could declare Section E adjourned until the Milwaukee meeting of June, 1939.

Despite conflicting meetings of geologists in New York and of geographers in Cambridge, Massachusetts, attendance at the sessions was good. About 250 persons were present at one or more meetings, though only twice did the number present in Lounge A at the Mosque exceed 100. The attendance record demonstrated three things: that the specialized fields and symposia to which Section E is devoting its attention at the winter meetings of the American Association are filling a definite need; that good attendance can be maintained for three days, provided good programs are planned; that some ingenuity is necessary to secure a good audience for the first meeting and to hold one through the last session.

SECTION ON ZOOLOGICAL SCIENCES (F) AND ASSOCIATED SOCIETIES

(From reports by George F. Baitsell, E. G. Butler, Ernest M. Cory, Clarence E. Mickel and O. R. McCoy

The Section on Zoological Sciences (F) met in joint sessions with the American Society of Zoologists and other associated societies at the Richmond meeting. It also joined with the Sections on the Botanical Sciences (G) and the Historical and Philological Sciences (L) in a symposium commemorating the "Centenary of the Cell Theory," which, as will be seen from the report under Section L, was of unusual importance and interest. In point of attendance and sociability the Biologists' Smoker, in which all the societies associated with the Botanical and Zoological Sections unite in a common meeting, proved as usual to outrank all other meetings. This smoker, however, has grown so large and unwieldy that it would seem as if consideration might profitably be given to some other arrangement which, perhaps, might offer some improvement over the present extremely congested conditions. On the following evening the annual dinner of the zoologists was held at the Hotel Richmond with an address by the chairman of the section, F. B. Sumner, on the subject, "Human Psychology and Some Things Fishes Do."

The thirty-sixth annual meeting of the American Society of Zoologists (E. G. Butler, *secretary*) was held on December 28, 29 and 30 in conjunction with Section F and in association with several other biological societies. Of special significance were (1) the outstanding character of the three symposia, (2) the large number of general papers presented and (3) the size of the meeting from the standpoint of general attendance.

The first symposium, under the leadership of the vice-president of the society, T. S. Painter, was held jointly with the Genetics Society of America. The four participants in this symposium presented a critical review of chromosome structure. It was estimated that nearly 1,000 persons were in attendance at this symposium, which is undoubtedly the largest number ever to attend a symposium arranged by the American Society of Zoologists.

The two other symposia were organized by former presidents of the society, G. H. Parker and H. S. Jennings. Dr. Parker's symposium dealt with a review of the problem of color changes in animals, their significance and activation. Dr. Jennings's symposium included a comprehensive discussion of the recent work on mating types and their interactions in ciliate infusoria with respect to determination, inheritance and relation to sexuality.

The number of papers to be read in person was the largest which has ever appeared on the program of the American Society of Zoologists. In all, 134 papers, exclusive of demonstration papers, were presented at the Richmond meeting of the zoologists. Ten regular sessions for the reading of papers were held, in addition to the three symposia and a single afternoon demonstration session.

Although no accurate figures are available, it was estimated that approximately 500 persons attended the regular sessions of the society. The annual dinner of the American Society of Zoologists was held on Thursday evening, with 230 persons attending.

At the annual business meeting held on Thursday, December 29, the following officers of the American Society of Zoologists were elected: *President,* J. T. Patterson, University of Texas; *vice-president,* H. B. Goodrich, Wesleyan University; *treasurer,* T. C. Nelson, Rutgers University; *member of the executive committee,* M. H. Jacobs, University of Pennsylvania.

The fifty-first meeting of the American Association of Economic Entomologists (Ernest M. Cory, *secretary*) was held from December 26 to 30, with probably the largest attendance the society has ever had. The outstanding feature of the meeting was the joint symposium with the Entomological Society of America and the Ecological Society of America on Tuesday afternoon on "Insect Populations," under the chairmanship of V. E. Shelford. The following papers were presented: "Insect Population Problems in Relation to Insect Outbreaks," by Royal H. Chapman, Honolulu, Hawaii; "Population Studies of Soil Insects," by Kenneth M. King, Saskatoon, Canada; "Populations of Social Insects," by Alfred E. Emerson, Chicago; "Forest Insect Populations," by Samuel A. Graham, Ann Arbor; and "Insect Populations in Relation to Biological Control," by Harry S. Smith, Riverside, Calif.

The Economic Entomologists and the Entomological Society of America joined in a banquet on Wednesday night, at which the public address of the Entomological Society of America was presented by C. T. Brues of Cambridge, Mass., entitled "Food, Drink and Evolution." There were 325 present at the dinner. At this dinner duplicate medals were awarded to E. H. Seigler and Lyle D. Goodhue for the outstanding paper presented at the Eastern Branch meetings, "The Effect of Particle Size of Some Insecticides on Their Toxicity to Codling Moth Larvae," and the cash award was divided equally between the two authors.

There were 74 papers presented at the general sessions, and 24 on the programs of sectional meetings. A new "Section on Teaching" was organized and approved at the final business session. Supplementary conferences were held on the pea aphis and on tobacco insects by the Tobacco Insect Council.

Two hundred and ninety-seven persons registered for this association, and approximately 500 attended the symposium.

The Entomological Society of America (Clarence E. Mickel, *secretary*) held its thirty-third annual meeting on Tuesday, Wednesday and Thursday. The 32 papers presented during the regular session were about equally divided between the fields of morphology, taxonomy, physiology and ecology of insect life. One of the features of the program was the showing of color motion picture films of insect life by A. L. Melander and Mrs. C. T. Brues, with one additional film on the color vision of insects prepared by Dr. Dora Ilse, of Cambridge, England.

A joint symposium was held on Tuesday afternoon with the American Association of Economic Entomologists and the Ecological Society of America on "Insect Populations." It was pointed out in this symposium that the problem of insect populations is a fundamental one for the field of economic entomology, and that all problems connected with outbreaks of insects are related to this basic problem of populations. The subject-matter of the symposium was presented from several points of view, namely, in relation to insect outbreaks, in relation to soil insects, in relation to forest insects, in relation to social insects and in relation to the problems of the biological control of insects. There was considerable discussion after the symposium papers had been presented, and it is hoped that one result will be the stimulation and expansion of work in this more or less neglected field. The papers presented at the symposium will be published as a single number of *Ecological Monographs* and may be secured by sending $1.00 at once to the Duke University Press, Durham, North Carolina.

The presiding officer at the Richmond meeting was President A. L. Melander. Officers for 1939 are: *President,* E. M. Walker; *first vice-president,* Ann H. Morgan; *second vice-president,* G. F. Ferris; *secretary-treasurer,* Clarence E. Mickel.

The American Society of Parasitologists (O. R. McCoy, *secretary*) held its fourteenth annual meeting on Wednesday, Thursday and Friday under the presidency of Dr. F. C. Bishopp. The program was the largest in the history of the society and contained 86 titles, representing the fields of protozoology, helminthology and medical entomology. The morning session of the opening day was devoted largely to papers on the incidence, diagnosis and treatment of human parasites. The Wednesday afternoon session consisted of reports of researches on parasites of veterinary importance and was featured by a report by R. W. Glaser and Norman R. Stoll of the cultivation in artificial media of the early parasitic stages of the sheep stomach worm, *Haemonchus contortus.* This work represents an important step toward the solution of the problem of the artificial cultivation of worm parasites, which has baffled helminthologists for a long time.

The presidential address on the subject, "Some Problems in Medical and Veterinary Entomology," was delivered by F. C. Bishopp at the conclusion of the Thursday morning session. The annual luncheon of the society, attended by 115 members and guests, was held on Thursday noon. In the afternoon, 22 papers were presented in a demonstration program during which tea was served. The concluding sessions on Friday were devoted mainly to papers on trematode life histories and to reports of immunological studies of protozoan and helminth parasites.

At the annual business meeting of the society the following officers were elected: *President,* Horace W. Stunkard; *vice-president,* Henry E. Meleney; *treasurer* for two years, Gilbert F. Otto; *members of the council* (to serve four years), E. R. Becker and E. W. Price; *members of the editorial board* (to serve four years), Asa C. Chandler, Cornelius B. Philip and E. E. Tyzzer. Colonel Charles F. Craig was unanimously elected a life member of the society. Professor Lauro Travassos, Instituto Oswaldo Cruz, Rio de Janeiro, and Dr. C. M. Wenyon, director of the Wellcome Bureau of Scientific Research, London, were elected foreign honorary members.

SECTION ON BOTANICAL SCIENCES (G) AND ASSOCIATED SOCIETIES

(*From reports by J. T. Buchholz, George S. Avery, Jr., Edwin M. Betts, J. M. Schopf, H. W. Popp, Ivey F. Lewis, R. S. Kirby, F. P. Cullinan and Edgar T. Wherry*)

The Section on Botanical Sciences (J. T. Buchholz, *secretary*) met in joint session with the associated societies (Botanical Society of America, the American Phytopathological Society, the American Society of Plant Physiologists, the Mycological Society of America, the Sullivant Moss Society and the American Fern Society) on Wednesday afternoon, December 28, in the auditorium of the Jefferson Hotel, with an attendance of more than 600. Dr. R. J. Pool, chairman for Section G, presided.

The program consisted of the address of the retiring vice-president and chairman for the section, Dr. F. E. Denny, of the Boyce Thompson Institute for Plant Research, and four members by invitation. Dr. Denny traced the history of the effect of ethylene on plants, first considered very harmful to greenhouse plants even in very low concentrations, later becoming known as a useful product in certain processes such as in promoting the ripening of fruits, and he has now demonstrated that ethylene is a normal product of metabolism in plants. Dr. A. F. Blakeslee discussed the present and potential service of chemistry to plant breeding, which includes the use of colchicine in the production of polyploids in a large variety of plants and greatly extends the methods available in the improvement of useful plants. Dr. W. J. Robbins described the rôle of thiamin (Vitamin B_1) in plant growth, illustrating its effect on the growth of various fungi and the excised roots of higher plants. Dr. I. W. Bailey described the microfibrillar and microcapillary structure of cell walls, with special reference to the nature and construction of the secondary wall in plant cells. Dr. A. J. Riker described the recent work on the relation between host and parasite in crown gall.

The Botanical Society of America (George S. Avery, Jr., *secretary*) held its thirty-third annual meeting from December 28 to 30, Professor Robert F. Smart, of the University of Richmond, being in charge of local arrangements for the society. The program was held under the auspices of the society's four sections, and 143 papers were presented. The annual dinner for all botanists was held on Thursday evening at the Jefferson Hotel, which was attended by nearly 400 botanists. Arthur J. Eames, president of the Botanical Society of America, presided at the dinner and introduced Edmund Ware Sinnott, retiring president, who spoke on "The Cell and the Problem of Organization."

The following are officers of the Society for 1939: *President,* Karl M. Wiegand; *vice-president,* Merritt L. Fernald; *secretary,* George S. Avery, Jr.; *treasurer,* Paul Weatherwax; *business manager of the American Journal of Botany,* F. E. Denny; *editor of the American Journal of Botany,* Sam F. Trelease.

The General Section of the Botanical Society of America (Edwin M. Betts, reporting) held four sessions in the Jefferson Room of the Jefferson Hotel, one of which was a joint meeting with the Ecological Society of America. The papers presented at the opening session were concerned mainly with phases of sexuality and chromosome numbers in plants. Two papers dealt with sexuality in the fungus *Ascobolus.* John M. Beal, Ronald Ramford and J. T. Baldwin gave chromosome numbers in *Calochortus, Tulipa* and *Crassulaceae.* George H. Shull presented an interesting paper on a new gene mutation, *Oenothera, mut. contracta.* Two cytological papers were presented on the genus *Lilium* by O. J. Eigsti and Lewis E. Anderson, the former showing the effect of colchicine upon the division of the generative cell in the pollen tube, while Anderson concluded that both plastids and mitochondria are present in the cytoplasm of each gamete, the inclusions being derived from the generative cell.

The second session was held jointly with the Ecological Society of America, B. W. Wells, University of North Carolina, presiding. Various aspects of ecology were discussed, the papers presented running almost the entire gamut of habitats and situations.

At the Thursday afternoon session the papers read dealt mainly with the subject of morphology. Among many worthwhile papers may be mentioned: "Vascular Tissues in the Gametophyte of *Psilotum,*" by John E. Holloway; "The Types of Stigmas in the Juglandaceae," by W. E. Manning; "Development and Histology of Fruit of the Sour Cherry from Pre-bloom to Fruit Ripening," by H. B. Tukey; and "Seedling Anatomy and Classification in the *Gramineae,*" by Paul Weatherwax. As the final paper of this session, Walter T. Swingle gave an illuminating talk on "New Research Methods for the Study of Economic Plants."

The Friday morning session centered around a Symposium on Chloroplastids. Interesting papers were presented by Elliot Weier, on "Silver Nitrate Reaction and its Relation to Chloroplast Structure"; by Lewis Knudson, on "Evidence of Existence of a Membrane"; and O. L. Inman, on "The Condition of Chlorophyll in the Chloroplasts." Before the symposium, E. W. Sinnott discussed "The Relation between Cell Division, Cell Enlargement and Growth Rate," and Edwin B. Matzke and James W. Marvin gave papers on cell shapes.

Officers of the general section of the society for 1939 are: *Chairman,* P. D. Strausbaugh; *secretary,* Lewis H. Tiffany.

The Paleobotanical Section (J. M. Schopf, reporting) held the second meeting since its organization, the program consisting of scientific papers and demonstrations of fossil plant material. The occurrence of large silicified *Sequoia* stumps in the Gallatin fossil forest of Wyoming was discussed by P. A. Young. L. R. Wilson showed slides of several new species of small spores isolated by maceration from coal beds of Des Moines age in Iowa and discussed their distribution. A new *Medullosa* with two asymmetric steles was described by J. M. Schopf. Its close relationship with older English species was indicated. Charles B. Read described additional new plants from the Upper Devonian. These are allied with the Psilophytales to a considerable extent, and they indicate that there is a much less abrupt break between the Upper and Middle Devonian floras than was previously supposed. L. C. Petry read C. A. Arnold's paper on fructifications of *Archaeopteris.* From evidence presented it is indicated that *Archaeopteris* was heterosporous. Although this plant is on a fern level of organization its direct relationship may actually be with later seed plants.

Mr. Read presented a demonstration of Devonian psilophyte material. The preparations were unusual, since many of these plants are preserved in pyrite, and the structure is brought out by means of reflected illumination. Mr. Harlan P. Banks demonstrated some interesting specimens of *Protolepidodendron,* also of Upper Devonian age. Miss B. K. Stewart showed an interesting pecopterid fructification from the base of the Dunkard series in western Pennsylvania. Examples of a Pteridosperm synangium (*Dolerotheca*) and a *Mazocarpon* cone from the Calhoun locality in Illinois (middle McLeansboro age) were shown by J. M. Schopf, in addition to preparations of the new distelar *Medullosa.*

Officers of the Paleobotanical Section of the society elected for 1939 are: *Chairman,* C. A. Arnold; *secretary,* J. M. Schopf.

The program of the Physiological Section (H. W. Popp, reporting) consisted of four regular sessions, with a total of 53 papers, and three special sessions at which 18 additional papers were presented. The program for the regular sessions was carried out in cooperation with the American Society of Plant Physiologists in such a way as to avoid simultaneous sessions dealing with the same subject. To accomplish this, 14 papers of the section were transferred to the program of the American Society of Plant Physiologists, and

14 of the papers of the society were transferred to the program of the section. Of the four regular sessions of the section, one dealt chiefly with dormancy and germination (11 papers), another with water relations and translocation (13 papers), and the two remaining with growth-promoting substances (28 papers).

The subject of the first of the special sessions was "The Effects of Water-soluble Growth-promoting Substances on Plants"; of the second, "Influence of Low Temperature on Plants"; and of the third, "The Physiology and Diseases of Cotton." The second special session was carried out in cooperation with the American Society for Horticultural Science and the American Society of Plant Physiologists. The one on "The Physiology and Diseases of Cotton" was a joint session of the Physiology Section with the American Phytopathological Society and the American Society of Plant Physiologists. All sessions were unusually well attended.

The new officers of the Physiological Section for the coming year are: *Chairman,* J. M. Arthur; *vice-chairman,* E. C. Miller; *secretary-treasurer,* P. R. Burkholder; *advisory member,* Division of Biology and Agriculture, National Research Council, B. M. Duggar. The new Physiological Board members are: J. M. Arthur, *chairman;* E. C. Miller, H. S. Reed, W. J. Robbins and P. R. Burkholder.

The Systematic Section (Ivey F. Lewis, reporting) held a full program with large attendance and lively interest. The feature paper was by M. L. Fernald on "Last Survivors in the Flora of Tidewater Virginia." Many range extensions and new observations were reported. Other papers on the botany of Virginia and neighboring states were given by H. L. Blomquist, John M. Fogg, Jr., Earl L. Core, A. B. Massey, H. K. Svenson, Carleton R. Ball and Lloyd G. Carr.

Other papers concerned with the myxophyceae and diatoms were presented by Francis Drouet, E. M. West and Ruth Patrick. There was marked interest in the relation of anatomy and fundamental structure to classification. Harold A. Senn, of the Canadian Department of Agriculture, discussed the relation of anatomy and cytology to the classification of Leguminosae. Comparable fundamental papers were discussed by John T. Buchholz, James B. McNair, Vernon I. Cheadle, Fred H. Taylor and Charles Heimsch, Jr.

Considerable interest was shown in papers on exotic floras by S. F. Blake, J. P. Carabia (Cuba), F. R. Fosberg (Polynesia), T. J. Yuncker (Honduras), David Potter (Newfoundland), A. C. Smith (British Guiana). Of more varied interest were papers on the mangrove vegetation of Florida (J. H. Davis, Jr.) floristic changes in the prairie region (Raymond J. Pool) and the sedges of the Pacific Coast (J. P. Stacey).

More strictly systematic were papers by Roland M. Harper, Francis W. Pennell, H. A. Gleason and Edgar T. Wherry. Other papers ranged from stock-poisoning plants in Maryland, by George B. Reynard, to the anatomy of the spider lily seed by Muriel Whitehead and Clair A. Brown.

The program was arranged in cooperation with the American Society of Plant Taxonomists. The Taxonomists' dinner, attended by the members of the section, was featured by a most informing and interesting address by President M. L. Fernald.

Officers of the Systematic Section of the society for 1939 are: *Chairman,* John H. Schaffner; secretary, Clyde H. Jones.

The American Phytopathological Society (R. S. Kirby, *secretary*) had a successful and well-attended meeting from December 27 to 30. C. R. Orton, of West Virginia University, was elected president for 1939. Charles Chupp of Cornell University was elected vice-president, and H. W. Anderson, of the University of Illinois, and E. B. Lambert, of the U. S. Department of Agriculture, were elected councilors. Mrs. Agnes E. Meier was appointed advertising manager of *Phytopathology* and Neil E. Stevens, H. R. Rosen, F. J. Stevenson and A. J. Ullstrop were appointed as assistant editors of *Phytopathology* to fill vacancies on the editorial board.

About 250 members were present at the scientific sessions and the annual dinner was attended by approximately 360. Election of 68 new members brought the active enrolment of the society to 1,076. The scientific program included 143 papers, presented before 14 sessions, in addition to special conferences on problems relating to regulatory work and plant quarantines, on the nomenclature of plant viruses and on extension methods in plant disease control and their results.

The society, appreciating the importance for the advance of science of cooperating with scientists in related fields, held the following joint sessions with other societies: (1) On Wednesday afternoon, with the Section on Botanical Sciences and six associated societies, under the chairmanship of R. J. Pool; on Thursday afternoon, with the Section on Plant Quarantine and Inspection of the American Association of Economic Entomologists, Howard P. Barss presiding; on Friday morning, with the Potato Association of America, Donald Reddick presiding; also on Friday morning, with the Floriculture Section of the American Society for Horticultural Science, Richard P. White presiding; also on Friday morning, with the Mycological Society of America, L. O. Overholts presiding; and also on Friday morning, the Physiological Section of the Botanical Society of America and the American Society of Plant Physiologists, G. M. Armstrong presiding.

On Tuesday afternoon the society held a general session at which 6 papers were presented. On Wednesday morning the society held a session on "Fruit Diseases," at which 11 papers were presented, E. M. Hildebrand presiding; at the same time two sessions were held, one on "Cereal Diseases," at which 12 papers were presented, J. J. Christensen presiding; and another on "Truck Crop Diseases," at which 13 papers were presented, C. C. Chupp presiding. On Thursday morning three sessions were held, one on "Tobacco Virus and Other Diseases," at which 11 papers were presented, W. D. Valleau presiding; one on "Forest Pathology," at which 12 papers were presented, Curtis May presiding; and one on "Fungicides and Miscellaneous Plant Diseases," at which 14 papers were presented, J. G. Leach presiding. On Thursday afternoon two sessions were held, one on "Virus Diseases," at which 9 papers were presented, James Johnson presiding; and one on "Tomato Diseases," at which 7 papers were presented.

On Wednesday evening the society held its annual dinner, following which it joined the Biologists' Smoker.

The American Society of Plant Physiologists (F. P. Cullinan, *secretary*) held its fifteenth annual meeting from December 28 to 30. The opening session on Wednesday was devoted to papers dealing with chlorophyll and photosynthesis, which proved to be very interesting, with reports of studies on plants ranging from the algae to full-grown apple trees. Papers on this general subject were continued at the Thursday afternoon session, showing the response of plants to differences in quantity and quality of light. The general sessions of the society on Friday dealt largely with papers on the chemical composition of plants, including vitamins, plant nutrition and plant chemistry.

In addition to the regular sessions of the society, three joint sessions were held, one on Wednesday afternoon with the botanical societies; a second on Thursday morning with the American Society for Horticultural Science and the Physiological Section of the Botanical Society of America, L. H. MacDaniels presiding; and a third on Friday morning with the American Phytopathological Society and the Physiological Section of the Botanical Society. Papers given at the Wednesday afternoon joint session with the Section on Botanical Sciences were of particular interest to plant physiologists. The Thursday morning joint session was a symposium on "The Influence of Low Temperatures on Plants," L. H. MacDaniels presiding. Papers dealing with the mechanism of cell behavior when exposed to low temperatures were considered at this session. In addition to the cellular papers, the effects on the entire plant, both herbaceous and woody, and on plant organs were discussed. The joint session held with the American Phytopathological Society and the Physiological Section of the Botanical Society of America on Friday morning proved very interesting, especially to physiologists from the cotton-producing states. The symposium subject was on "The Physiology and Diseases of Cotton," with G. M. Armstrong presiding. These papers were grouped around the development of the cotton boll and studies dealing with the root rot organism *Phymatotrichum omnivorum*, one of the destructive root rots of cotton, and and on the Fusarium wilt disease of cotton.

In addition to the papers presented in the general sessions, the society cooperated with the Physiological Section of the Botanical Society of America in an exchange of papers in order to coordinate the presentation of subject-matter and to avoid duplications in the two sections, which ran concurrently.

One of the outstanding features of the meeting was the annual dinner of the society, held in the Winter Garden Room of the Richmond Hotel on Wednesday evening, at which announcement was made of the award of the Charles Reid Barnes honorary life membership, which went to Dr. Professor Ludwig Yost, of Heidelberg, Germany.

Announcement was also made of the Stephen Hales award to John W. Shive, head of the department of plant physiology, New Jersey Agricultural Experiment Station, for conspicuous research in the field of plant nutrition.

The retiring president of the society, O. F. Curtis, presented a very stimulating paper on "Education by Authority or for Authority? Are Science Teachers Teaching Science?", in which he discussed both undergraduate and graduate teaching of the present day, giving numerous examples of the danger of teaching by authority. At the close of the dinner meeting a report on the Zurich International Cytology and Physiology Congresses was made by Basile J. Luyet, of St. Louis University, illustrated by a motion picture showing famous physiologists who were known either personally or by reputation to the members of the society.

The final session of the society, on Friday evening, consisted of a symposium on "The Teaching of Plant Physiology," Burton E. Livingston presiding.

The American Fern Society (Edgar T. Wherry, *president*) met on Saturday, December 31, with 30 members and guests in attendance. Talks were given on notable ferns of Virginia and adjoining states, illustrated by specimens and lantern slides. Numerous specimens and habitat photographs from other parts of the United States were also exhibited and discussed.

The Mycological Society of America held four sessions, at which 42 papers were presented, in addition to a joint session on Wednesday afternoon with the Section on Botanical Sciences and its associated societies and a joint session on Friday morning with the American Phytopathological Society.

The Sullivant Moss Society held one session, at which 12 papers were presented, in addition to a joint session with the Section on Botanical Sciences and its associated societies.

SOCIETIES RELATED TO THE SECTION ON ZOOLOGICAL SCIENCES (F) AND THE SECTION ON BOTANICAL SCIENCES (G)

(From reports by Ralph E. Cleland, Orlando Park, E. W. Lindstrom, J. E. Ackert and Paul S. Welch)

The American Society of Naturalists (Ralph E. Cleland, *secretary*), which holds an annual symposium, this year joined with the American Society of Zoologists, the Botanical Society of America, the Genetics Society of America and the Section on Anthropology (H) in a discussion on "Contributions of the Higher Animals to an Understanding of Human Biology." G. K. Noble discussed "The Experimental Animal from the Naturalists' Point of View," emphasizing and comparing social organization in the various groups from fish to man. He showed that the same components of social behavior may be recognized in the various groups and indicated how forebrain mechanisms essential for social behavior have shifted from the corpus striatum of fish and birds to the cortex of mammals. C. C. Little, presenting "Some Contributions of the Laboratory Rodents to our Understanding of Human Biology," indicated the advantages of rodents over other animals for research purposes, and outlined the major contributions to medical and biological knowledge which have resulted from their utilization. C. G. Hartman spoke on "The Use of the Monkey for the Study of Human Biology." He discussed in particular recently acquired knowledge of reproductive processes in apes and monkeys and showed how it substantiates the general conclusions with regard to the phylogenetic position of man that had previously been drawn on morphological grounds.

The presidential address was delivered by Dr. Robert M. Yerkes before a large audience at the Naturalists' dinner. This paper, entitled "The Life-history and Personality of the Chimpanzee," was illustrated by moving pictures and outlined clearly the chief physical, physiological and psychological traits of the chimpanzee.

The Ecological Society of America (Orlando Park, *secretary*) held its twenty-fourth annual meeting from December 28 to 30, at which 57 research papers and an important symposium were presented in 8 sessions. On Tuesday morning the society divided into two sections, the first on "Plant Ecology," H. C. Hanson presiding, at which papers were presented by J. E. Weaver, Raymond J. Pool, Charles J. Whitfield, Thomas F. Hull, Jr., and William T. Penfound, Frank E. Egler, Henry J. Oosting and Lewis E. Anderson, and William H. Gates. The second section on Tuesday morning was on "Animal Ecology," A. H. Wright presiding, at which papers were presented by Curtis L. Newcombe and Boland B. Shepperd, David H. Wallace, R. A. Littleford, R. V. Truitt, Z. P. Metcalf and Lee R. Dice.

On Tuesday afternoon a joint symposium was held by the society with the American Association of Economic Entomologists and the Entomological Society of America on the subject of "Insect Populations." The first of the invitational papers was on "Insect Population Problems in Relation to Insect Outbreaks," by Royal N. Chapman, and this was followed by "Population Studies of Soil Insects," by Kenneth M. King. The third paper was by Alfred E. Emerson on "Population of Social Insects," and this was followed by "Forest Insect Populations," by Samuel A. Graham. The final paper was presented by Harry S. Smith on "Insect Populations in Relation to Biological Control." Discussion of the papers at the close of the symposium was led by V. E. Shelford, presiding officer of the session.

The Wednesday morning sessions were in two sections, the first of which was on "Animal Ecology," Orlando Park presiding. Papers were presented by E. R. Dunn, Stanley C. Ball, Eugene P. Odum, S. C. Kendeigh, William C. Van Deventer and W. J. Hamilton, Jr.

The second Wednesday morning section, on "Plant Ecology," George D. Fuller presiding, opened with excellent moving pictures of Nevill's Colorado River expedition of 1938 by Elzada N. Clover. Other papers were by Moras L. Shubert and J. M. Aikman, J. M. Aikman and Richard Dilworth, R. S. Campbell, B. W. Wells, Stanley A. Cain and Olga Lakela.

The Wednesday afternoon session was also in two sections, the first of which was a joint meeting of the society with the Society of American Foresters, with C. F. Korstian presiding. Papers were presented by Hardy L. Shirley and Lloyd J. Meuli, W. E. McQuilkin, C. F. Korstian and M. A. Huberman.

The second Wednesday afternoon section was a "General Ecological Session" under the chairmanship of A. S. Pearse. At this session papers were presented by Charles C. Adams, Roland M. Harper, Edward Haskell, Stanley C. Cain, Paul D. Voth, A. P. Dachnowski-Stokes and Eldon J. Strandine.

The annual dinner of the Ecological Society of America was held on Wednesday evening, at the close of which H. C. Hanson delivered his presidential address. Following the presidential address, B. W. Wells gave an illustrated lecture on the North Caroline Transect.

On Thursday morning the society met jointly with the Botanical Society of America, B. W. Wells presiding. Papers were presented at this session by Francis Ramaley, A. L. McComb, William T. Penfound, Paul D. Voth, G. S. Avery, Jr., H. B. Creighton and C. W. Hock, Paul M. Patterson, P. L. Ricker, Forrest Shreve and T. D. Mallery, John A. Small, Willis A. Egler, Morgan W. Evans and George E. Nichols.

The following officers for 1939 were elected: Charles T. Vorhies, *president;* C. F. Korstian, *vice-president;* W. J. Hamilton, *secretary.*

The Ecological Society's program closed with an all-day field trip to the Dismal Swamp.

The Genetics Society of America (E. W. Lindstrom, *secretary*) met on Wednesday and Thursday and on Friday morning, with a program of 60 papers.

Modern advances in genetic research were illustrated and discussed in two large demonstration sessions, featuring the induction of variations by colchicine treatment; polyploidy studies in many species; cytogenetical aspects of plants and animals; influence of polyploidy on sex; mutations and reverse mutations in *Drosophila;* inheritance of dental caries in rats; heredity in corneteosinte hybrids; sex-determination in the Amaranthaceae; and fasciation in plants. Six invitation papers dealt with recent work on triploidy in salamanders, *Sciara* cytology, wheat cytogenetics, *Drosophila* evolutionary studies, reversal of lethal factors in *Drosophila* (showing that such lethals could not be due to deficiencies) and the effect of ultra-violet radiation on variability and mutations in the fungus causing athlete's foot. Mutations in color, colony form and growth rate of this fungus were obtained from exposures to a very narrow series of wavelengths. In a fourth session devoted to scientific papers, the following points were notable: a simple hypothesis based on the helical coiling of chromosomes to account for numerous chromosome rearrangements traceable to one hit by an x-ray quantum; the study of a monogenic base for hermaphroditism in goats interacting with the endocrines; the physiological-genetical individuality of inbred lines of corn as measured by nutrient culture studies with the nitrate and ammonium ions; a study of breeding methods in poultry; and an experiment giving proof of natural selection in the laboratory with a bacterial species whose degree of virulence and colony morphology were markedly changed by passage through resistant or susceptible maize hosts. Joint sessions were held with the American Society of Zoologists and with the American Society of Naturalists.

The attendance at the Genetics Society luncheon numbered 140.

Officers for 1939 were elected as follows: M. Demerec, *president;* Barbara McClintock, *vice-president.*

The American Microscopical Society (J. E. Ackert, *secretary*) held its annual meeting on Thursday, December 29. The reports of officers and committees showed that the society is in sound financial condition and its membership increasing. The Sixtieth Anniversary Volume (1938) of the society's quarterly Transactions consisted of 420 pages of original material on biology and microscopy.

Officers elected for 1939 were as follows: Dr. L. E. Noland, University of Wisconsin, *president;* Dr. G. W. Martin, University of Iowa, *first vice-president;* Dr. H. W. Manter, University of Nebraska, *second vice-president;* and Dr. Samuel A. Eddy, University of Minnesota, *member of executive committee.* The members chosen to represent the society on the council of the American Association for the Advancement of Science were J. E. Ackert, *secretary,* and A. M. Chickering, *treasurer.*

The Limnological Society of America (Paul S. Welch, *secretary-treasurer*) held its fourth annual meeting on Wednesday and Thursday, December 28 and 29. The scientific program consisted of 20 papers, with 6 additional papers read by title. The papers dealt with various limnological investigations, such as fresh-water medusae, bacteria of lakes, microscopic organisms of mine-waste waters, general limnological surveys of lakes, limnological methods, bottom communities of Lake Erie, investigations on the Norris Reservoir, diatomaceous deposits, sedimentary deposits in Sandusky Bay, phosphates in Chesapeake Bay and light penetration in water. A prominent feature of the program was a group of papers dealing with density currents, an outstanding one of which described underflows of sediment-laden waters in reservoirs and showed by moving pictures the behavior of density currents in specially designed apparatus.

Both sessions of the second day were devoted to a symposium on the general topic, "Some Leading Problems of Limnology with Special Reference to Lakes." This symposium consisted of 9 papers by invited speakers. In brief, the papers of this symposium dealt with such problems as the following: physical and chemical factors in the metabolism of lakes, utilization of solar energy by aquatic organisms, distribution of bacteria in lakes, relationships of phytoplankton to limnology, relation of zooplankton to the metabolism of lakes, microscopic fauna of sandy beaches, relation of rooted aquatic plants to limnology, role of bottom fauna in productivity and the position of fish and other higher animals in the economy of lakes.

The following officers were elected: *President,* L. H. Tiffany, Northwestern University; *vice-president,* G. E. Hutchinson, Yale University; *secretary-treasurer,* Paul S. Welch, University of Michigan; *elective member of the executive committee,* E. P. Cheatum, Southern Methodist University.

The National Association of Biology Teachers held two sessions, before which 8 papers were presented. On Wednesday evening it held its dinner, at which Dr. Oscar Riddle spoke on "The Opportunity and Obligations of the National Association of Biology Teachers."

SECTION ON ANTHROPOLOGY (H)

(*From report by W. M. Krogman*)

The sessions of the section were attended by 30 persons; 15 papers were presented, mostly on two major themes, the evolution of man and the development and adaptations of his culture.

W. K. Gregory and Milo Hellman reported on the skulls of *Plesianthropus* ("near man") found in South Africa by Robert Broom. In characters of skull-cap, face and teeth the fossils are intermediate between apes and man. Their geological age is too recent to rank them as man's ancestors; they are, rather, his cousins, and by virtue of this kinship afford valuable insight into degrees of relationship. Diamond Jenness discussed cultural origins in Asia-America contacts during prehistory. A specific tie-up between Alaska and the Amur River of Northwest Asia was indicated. E. F. Greenman and G. M. Stanley offered dated evidence of aboriginal culture in a site at Great Cloche Island on Lake Huron. The age given was 1,100 to 1,400 years ago, important in dating related cultural sequences. Leonard Bloom discussed the important problem of Indian-White cultural adjustment among the Eastern Cherokee. Four major periods were recognized: contact, 1540–1721; impact and retreat, 1721–1820; flight and precarious existence, 1820–1900; present, 1900–. R. B. Bean discussed the physical type of the Old Virginia Whites: A very tall, brown-haired, blue-eyed product of the amalgam of British, French and German settlers. The physical welfare of various racio-economic groups was outlined in the growth studies of Morris Steggerda. An annual seven-year study of Dutch (Mich.), Negro (Ala.), Navajo (Ariz.) and Maya (Yucatan) children demonstrated racial and environmental growth patterns, and contrasted the relation of individual and group growth.

In general discussion the several papers were analyzed with reference to their contribution to problems of present-day human relations. The evolutionary background, the emergency and conflict of cultures, the growth and stabilization of human types, all contribute to modern concepts of social origins and welfare.

SECTION ON PSYCHOLOGY (I)

(*From report by Leonard Carmichael*)

The Section on Psychology (I) reports again this year a most satisfactory series of meetings. In all more than 60 special communications, many of them of outstanding merit, were presented.

American psychologists as a whole are especially proud of the fact that this year for the first time in history the American Association Prize of $1,000 was awarded to a psychologist, presenting a paper on the program of this section. As reported elsewhere, the recipient of this prize was Professor Norman R. F. Maier, of the department of psychology of the University of Michigan. Professor Maier's prize-winning paper reported the development of "Experimentally Produced Neurotic Behavior in the Rat," the training procedures by means of which rats were deprived of their acquired modes of behavior and at the same time placed in a situation in which a positive reaction was required. As a result of this novel and ingenious treatment the rats developed a new and abnormal pattern of response. The abnormal behavior manifestations included running in circles on the floor, the demonstration of intensive tics and varying degrees of coma.

The symposium, "Research in Audition: The Next Step," organized by E. A. Culler, of the University of Rochester, was especially noteworthy. The following men participated in the symposium: J. C. Steinberg, Bell Telephone Laboratories; Don Lewis, University of Iowa; Fred A. Mettler, University of Georgia Medical School; E. G. Wever, Princeton University; E. H. Kemp, Brown University; Heinrich Kobrak, University of Chicago; Simon Dworkin, McGill University; and Walter Hughson, Abington Memorial Hospital. These investigators thus brought to bear the technique of physics, histology, electrophysiology, behavior psychology and clinical medicine in dealing with the insistent problems of normal hearing and deafness.

The retiring vice-president of Section I, Dr. Calvin P. Stone, of Stanford University, spoke at the joint dinner of the Section on Psychology and Education on "The Significance of Individual Differences in Animal Psychology." In this paper he presented much novel information on the causes of individual differences in animals, based in large part on a study of the records of race horses. Dr. Ralph W. Tyler, University of Chicago, retiring chairman of the Section on Education (Q), also presented a very important paper on "Basic Considerations in the Improvement of Educational Tests."

SECTION ON SOCIAL AND ECONOMIC SCIENCES (K)

(*From report by E. P. Hutchinson*)

Two papers were presented at the session on the Pareto distribution. In the first of these on "The Pareto Curve and its Social Significance for our Times," Carl Snyder presented statistical and graphical evidence of the universality of the Pareto distribution, showing how it is followed by a wide range of variables and how this form in the inequality in the distribution of wealth and income is to be observed in all occupations, in many types of society and at many different periods. The companion paper, "Social Implications of the Pareto Distribution of Special Ability," by H. T. Davis gave a mathematical formulation of observed distributions of income and ability, and presented a statistical measure of the degree of inequality in income distribution, this latter being suggested as a possible index of social stability.

In the symposium on "Land Use," held jointly with the Section on Agriculture (O), Rupert Vance, University of North Carolina, discussed problems of southern agriculture with reference to population and land use. G. W. Forster, of North Carolina State College, presented unpublished data, indicating the necessity for a careful planning of land use for each holding. H. H. Bennett, of the U. S. Soil Conservation Service, reported on government activities in land conservation and rural rehabilitation.

The Pi Gamma Mu luncheon presented brief addresses by Sir Richard Gregory, Wesley Mitchell and F. R. Moulton.

SECTION ON HISTORICAL AND PHILOLOGICAL SCIENCES (L)

(*From report by Joseph Mayer*)

The sessions of Section L centered primarily upon a symposium covering the "Cell Theory"—its development, its present status and its future possibilities—and combined the best thought of the three sections (F, G and L) that collaborated in organizing and presenting it. Seven outstanding papers by eminent scholars (and an eighth which was read by title only) were presented in the two sessions devoted to the symposium. The discussion and attendance throughout were exceptionally good, over 150 being present at the afternoon meeting.

The morning session, which was devoted to historical aspects of the cell theory, brought some surprising opinions respecting Schleiden and Schwann, who for a century have been given credit for the origin of the theory. It was the unanimous opinion of Woodruff, Karling and Conklin that not only had the cell theory been formulated prior to the work of Schleiden and Schwann, but that these two men added nothing either in content or in clarity to the theory and that they, in fact, lent support to a general view of cell formation which was completely erroneous. Dr. Conklin concluded his most interesting paper by suggesting that "it would be more accurate as well as more becoming to strike out of our literature these personal possession tags attached to important discoveries, such as "The cell theory of Schleiden and Schwann" !

The afternoon session of the symposium, devoted to the present and the future of the cell theory, developed an interesting difference in points of view between those who appear to see the problem primarily in terms of physical forces (surface tensions, pressures, electrical attractions and repulsions) and those who hold that living matter exhibits certain characteristics (such as variability, selective direction and unfoldment in a temporal sequence) which sharply differentiate the organic from the inorganic. It was generally agreed that the organization of the cell is exceedingly complex and that there is still much to be learned about it. Yet, on the one hand, it was maintained by Baitsell and Schrader that the difference between the organic and the inorganic is "not one of *kind* but merely of *degree of complexity*," and that a "dynamic hypothesis" seems the most reasonable one in explaining the complicated behavior of the cell nucleus. On the other hand, it was pointed out by Weiss and McClung that, although "the cells derived from an egg have definite, innate capacities of their own, the fact that the individual cell can differentiate in a variety of directions but actually differentiates only in one, calls for factors which direct each cell selectively into its proper course. These factors, by their very nature, are super-cellular." They apparently derive from the organism as a whole and suggest the presence of "racial material in a linear order within the chromosomes . . . since living systems have unique phenomena of a higher order (than the non-living), like reproduction, metabolism and consciousness, it is only logical to conclude that there must be units of a new order to explain them." It rests with the future, it was held, to effect a reconciliation between such points of view.

Besides the holding of the symposium on the "Cell Theory," the retiring chairman of Section L, Dr. R. C. Archibald, gave a most interesting address, illustrated with slides, on "Mathematics, and Poetry and Drama" at a joint session with Section A, the American Mathematical Society and the Mathematical Association of America. The attendance at the address was about 300.

SECTION ON ENGINEERING (M)

(*From report of Frederick M. Feiker*)

A half-day session of the Section on Engineering (M) was held on Thursday, December 29, on the general subject of the interrelation between "Economic Planning" and "Engineering Planning," Andrey A. Potter presiding. Three papers were presented as follows: "Engineering Planning *vs.* Planned Economy," by Dr. Joseph W. Barker, retiring chairman of the section; "Engineering Planning in its Relation to Agricultural Planning," by Professor Frank C. Vilbrandt; "The Place of the Map in our National Economy," by William Bowie, president, Society of American Military Engineers.

Dean Barker suggested that planning in an engineering sense involves the collection, coordination and interpretation of factual data in the formulation of plans to reach some objective. He pointed out that when planning involves social and economic objectives, it must depart essentially from engineering planning because there are no areas of fact for the analysis of the human equation for which factual data exist. He expressed the belief that so-called economic planning could only be true planning from the engineer's point of view if the individuals were regimented and the human factors of individuality and liberty in this way made stable. For this reason he doubted the success of a planned economy in a democratic society.

Professor Vilbrandt, in a provocative paper, suggested that agriculture and chemical engineering were finding a meeting ground in the production of raw and processed materials. He pointed out several chemical industries which were and still are in some parts of the world what he called "peasant farmer" products. His interesting analyses and parallels indicated that from the point of view of planning, changes are being made so rapidly as to outmode quickly the methods of obtaining planned objectives, and indeed may eliminate the objectives themselves.

Major Bowie's paper stressed the place of the map as a factual instrument of planning, not only for civil pursuits but for national defense.

The discussions of all three papers indicated that factual data and procedures must be greatly developed in the social and economic parts of planning, if planning in the long run is to succeed; and that engineers should cooperate with physical, chemical and social research agencies and organizations to stress the need of data so that the political agencies will not develop unbalanced plans on the basis of emotion and opinion instead of logic and facts.

Several speakers commended the leadership of the American Engineering Council in promoting interprofessional conferences on subjects of public interest in which representatives of the social sciences had opportunities to cooperate with engineers and further wider public understanding.

At the conclusion of the meeting, the delegates present discussed the opportunity to further the plans of Section M with the following results: It was voted to cooperate with the geologists and the agricultural engineers in a symposium on "Soil" at the Milwaukee meeting in June, 1939, and to look forward to possible cooperation with aeronautical sciences for a December, 1939, program at Columbus. It was also suggested that the Section on Engineering (M) might seek to further cooperation with social and physical sciences by arranging to sponsor, in cooperation with the founder engineering societies, a meeting during their annual meetings. This matter was left with Mr. Osborne, a representative delegate from the American Institute of Electrical Engineers, to explore.

Jerome Hunsaker, professor of mechanical engineering at the Massachusetts Institute of Technology, was nominated as chairman of the Section on Engineering (M) for the year 1939.

SECTION ON MEDICAL SCIENCES (N), SUBSECTIONS AND ASSOCIATED SOCIETIES

(*From reports by Malcolm H. Soule, Thomas J. Hill and H. B. Haag*)

The Symposium on "Mental Health" arranged by the Section on Medical Sciences was jointly sponsored by the American Psychiatric Association, the United States Public Health Service, the Mental Hospital Survey Committee and the National Committee for Mental Health. Six sessions, which ran consecutively, were held on Wednesday, Thursday and Friday, the average attendance being 175. A total of 49 papers were prepared in advance and made available in six printed brochures, one for each session. The contributions were not read at the symposium, the brochures being used as bases for discussions.

The program was inaugurated by Thomas M. Rivers, chairman of Section N. In his opening remarks Dr. Rivers criticized the setting apart of psychiatry as an isolated science. He charged the specialists to connect mental diseases with other phases of medicine and to stop overlaying this specialty with words because the impression is wide-spread that new words seemingly bring credit in psychiatry. With this challenge the symposium was introduced. The discussions that followed dealt with the genetic and biological bases of mental disorders, on the one hand, and the maladjustments between environment and biological functioning on the other. The philosophy of psychiatric research, the relationship of fundamental to applied research, the present status of psychiatric investigation and the role of academic and tax-supported research was discussed and evaluated.

The sessions on Thursday were devoted to an appraisal by statisticians, economists and social scientists of the magnitude and scope of the mental health problem, its financial and human costs, the manifold social problems associated with mental disease, their broad community and social aspects in terms of environmental causes and conditions and their modification and control. In connection with these sessions a series of excellent charts had been prepared and were mounted on display-frames about the lecture hall. In this manner the data were attractively arranged, enabling the layman to easily visualize the numerical relations. In the discussion, the enormous loss due to mental disease in terms of curtailed earning power and of public taxation for institutional maintenance was contrasted with the contribution of economic factors to mental breakdowns through maladjustments in industry and society.

On the third day attention was focussed on the practical aspects of the management and control of mental disease and disorders, public policy in the care and treatment of the mentally ill, the organization of mental health services and related matters. Particular attention was given to the pressing need for trained workers in the mental hygiene field, and to the problem of developing a technical personnel adequate to the needs.

The symposium, the most comprehensive ever held on the subject of mental health, was an outstanding success. The discussions not only advanced scientific knowledge but served as a vehicle for the very practical purpose of promoting public interest and support looking to fruitful, nation-wide social action toward the amelioration, prevention and control of mental illness. Mental illness is a national problem and needs an alliance of medical, scientific, educational and social forces for its solution.

On Wednesday afternoon, at the close of the session devoted to "Mental Hygiene," the Theobald Smith Award in Medicine, consisting of an appropriate bronze medal and a check for a thousand dollars, was presented to Charles F. Code, of the Mayo Foundation of the University of Minnesota. In an address which followed, Dr. Code presented his findings on the distribution of histamine in the components of the blood under normal conditions and at the time of anaphylactic shock.

The address of the chairman of the section, Dr. Rivers, given on Thursday afternoon, dealt with the nature of viruses. A comprehensive survey of the methods employed for the study of submicroscopic forms was outlined, and our knowledge of these agents was presented.

The tragic death on the Hawaii Clipper of Dr. Earl B. McKinley on July 29, 1938, brought to a close the activities of one who had given unstintingly of his time and energy to the program of the Section on Medical Sciences for six years, and his great contributions were fittingly commemorated in "An Appreciation" by H. B. Ward at the close of the regular symposium program on Friday morning.

On Friday evening the symposium was brought to a close by C. Macfie Campbell, who gave an address open to the general public on "Human Needs and Social Resources."

The Subsection on Dentistry (Thomas J. Hill, reporting) held its meeting on December 28 with sessions during the morning, afternoon and evening, the presiding officers being Drs. William J. Gies, Harry Bear and D. F. Lynch, respectively.

The scientific sessions consisted of a symposium on the causes and the contributing factors related to dental caries, at which 7 papers were presented. The morning session, devoted to a discussion of the influence of "Diet and Nutrition," was participated in by J. J. Reed, R. H. Brodsky, P. E. Boyle, Meyer Klatsky, G. J. Cox, L. M. Waugh, W. A. Cotton and Mrs. Anna deP. Bowes. The influence of a wholly adequate diet as a contributing factor to the incidence of caries was repeatedly emphasized, but was shown to be inadequate for the complete control of this disease. The "Bacterial" field was discussed by Drs. J. R. Blayney, E. H. Hatton and T. J. Hill. A method for determining areas susceptible to caries by the qualitative examination of smears and the influence of saliva on cultural growth of *L. acidophilus* was demonstrated. The "Heredity" factor was emphasized by Drs. Alfred Walker, Henry Klein and H. R. Hunt, with evidence to show that in both experimental animals and humans heredity plays some part. The influence of the "Tooth Structure" on incidence of caries was discussed by F. S. McKay, and "Distribution" by Mary M. Moore and J. A. Salzmann. The "Chemical" changes in saliva and their influence upon the production of caries, as well as a comparison of the amounts of saliva excreted and the incidence of caries in endemic areas of toxic fluorosis were discussed by J. C. Forbes, H. C. Trimble, C. L. Gunn, L. S. Fosdick, H. T. Dean, H. C. Hodge and C. C. Vogt. Abstracts of these papers will appear in the *Journal* of the American College of Dentists.

The following officers of the Sub-Section on Dentistry were elected for the year 1939: Dr. Paul C. Kitchin, *chairman* and *secretary,* Drs. J. L. T. Appleton and Thomas J. Hill, *members of the executive committee.*

The Subsection on Pharmacy (H. B. Haag, reporting) devoted its entire time to the symposium on "Glycols"—their chemistry, pharmacology, industrial applications and pharmaceutical uses. F. C. Whitmore was unable to be present to discuss his phase of the subject, namely, "The Chemistry of the Glycols."

H. O. Calvery gave the results of his most comprehensive toxicity tests on these compounds (propylene glycol, diethylene glycol, ethylene glycol, carbitol, dioxide and cellosolve) in which he used some 2,600 animals. He stressed and demonstrated the need of applying statistical methods to the results of toxicity studies. In his summary he concluded that, with the exception of propylene glycol, the others should be avoided in food and drug preparations.

H. B. McClure told of the industrial applications of the glycols in a most interesting manner. Among the uses cited were, as engine coolants, low-freeze dynamites, electrolytic condensors, plasticizers and in textile manufacture.

The pharmaceutical uses of the glycols were discussed by A. G. DuMez, who gave an extensive review of the literature on this subject. In the discussion, participated in by H. B. Haag and M. G. Mulinos, the desirability of comparing the toxicity of these compounds with some generally known solvent was indicated, as well as the need for studying the factors (age, sex, their chemicals, etc.) which might influence the intensity of the glycol action.

The attendance on the symposium was very good and striking in that it stuck, there being little or no moving about during the program. This was the first time that an attempt had been made to gather together in a comprehensive fashion all that is known about the glycols, and it is hoped that the papers will be published together so as to give a complete picture of these compounds.

The American Psychiatric Association joined with the Section on Medical Sciences in the symposium on "Mental Health." It held a dinner on Wednesday evening and a meeting of its council on Thursday evening.

SECTION ON AGRICULTURE (O) AND ASSOCIATED SOCIETIES

(From reports by M. F. Morgan, H. B. Tukey and William H. Martin)

In an address on "The Inter-relation of Soils, Plant and Animal Nutrition," delivered by E. C. Auchter as retiring vice-president of the association and chairman of the Section on Agriculture (M. F. Morgan, *secretary*), the rapid expansion of research dealing with mineral nutrition of plants, animals and men was emphasized. Dr. Auchter summarized the contributions of soil scientists toward establishing areas of soils notably deficient in one or more elements essential to plants or to the well-being of animals and humans subsisting upon them.

The program of the Symposium on "Land Use" held jointly with the Section on Social and Economic Sciences (K) was described in the report of the Section on Social and Economic Sciences (K).

The American Society for Horticultural Science (H. B. Tukey, *secretary*) met in 21 sessions, at which 247 papers were presented, covering the topics of orchard soils, fertilizers and nutrition; fruit tree rootstocks and propagation; physiology and pathology of fruit plants; fruit breeding; small fruits; propagation and breeding of ornamental plants; culture, physiology and improvement of the tomato; and vegetable varieties, breeding and seed improvement. Joint sessions were held with the American Society of Plant Physiologists and the Physiological Section of the Botanical Society of America; with the Potato Association of America; and with the American Phytopathological Society. Round table discussions were held on the topics of fruit varieties; vegetable varieties; raspberry breeding; educational methods and extension methods.

The annual banquet and social evening was held at the Commonwealth Club, with J. K. Shaw, of Massachusetts State College, delivering the presidential address on "Foundations." The pleasures of the evening were further enhanced by the presence of Liberty Hyde Bailey, first president of the society 35 years previously; by the singing of the Hampton Quartet; and by the presentation of motion pictures of historic Virginia.

One of the features of the organization, and of the Richmond meeting in particular, is the general bringing together of groups from all plant sciences, including the work of soil conservationists and soil experts, plant chemists and physicists, plant breeders and geneticists, entomologists, phytopathologists, workers in applied plant propagation and workers with synthetic growth substances, and workers on general problems of nutrition, morphology and physiology. All these are united for the solution of problems concerning horticultural plants, and it is this feature of the society and of its program which is the most arresting.

The twenty-fifth annual meeting of the Potato Association of America (William H. Martin, *secretary*) was the most interesting ever held by this organization. All the sessions, including the joint sessions with the American Phytopathological Society and the American Society for Horticultural Science, were well attended and a number of excellent papers were presented. In discussing "Twenty-five Years in the History of the Potato," F. A. Krantz stated that one of the outstanding achievements of this period was the development of types of potatoes resistant to the late blight organism, *Phytophthora infestans*. Much progress has been made also in developing varieties resistant to scab and the virus diseases.

The following officers were elected: *President*, Ora Smith, Cornell University; *vice-president*, C. H. Metzger, Colorado State College; *secretary-treasurer*, W. H. Martin, N. J. Agricultural Experiment Station; *executive committee:* F. A. Krantz, L. M. Ware, R. A. Jehle and L. S. McLaine.

SECTION ON EDUCATION (Q)

(From report by Percival M. Symonds, secretary)

The Section on Education (Q) held 8 sessions, at which 40 papers were read. The attendance at these meetings ranged from 21 to 58, averaging 32. The members and guests appreciated the fact that the sessions were not overcrowded with papers and that there was opportunity for considerable free discussion from the floor.

Two of the sessions were in the nature of symposia, in which the papers were all directed toward a discussion of a single topic. One of these was on "The Economic Effects on Education," of which W. G. Carr, director of research of the National Education Association, was chairman. Professor Harold F. Clark, of Teachers College, Columbia University, presented a paper discussing the present status and needed investigations in this field, and the session closed with a lively discussion. The other symposium, organized by W. H. Bristow, of the National Council of Parents and Teachers, included papers on "The Problems of Interpretation of the Results of Educational Research." These reports were by representatives from foundations, state departments of education and educational associations. All stressed the importance of giving more attention to the distribution of educational research.

One of the highlights of the meetings was the reports of national and state surveys in education. F. W. Reeves discussed the work of the President's Advisory Committee on Education. H. F. Alves presented some of the findings of the Study of Local School Units in Ten States. Walter C. Eells presented the plan and some outcomes of the Cooperative Study of Secondary Schools. M. M. Chambers presented some of the outstanding results of the work of the American Youth Commission.

A joint session with the Section on Psychology (I) included 8 papers. Noteworthy among these was Gesell's review of his ten-year study of infants from early infancy on into early adolescence. The charts and figures which were presented emphasized the uniformity of this progress according to some rate or gradient which seemed to be implicit in the progress at all levels.

A program on "Problems in Reading" included 4 papers. The scheduled chairman, Emmett A. Betts, was unable to attend, his place being taken by Dr. John C. Seegers. Dr. Betts is planning to publish the papers of this session in a forthcoming issue of the *Elementary English Review.*

A round table on "Mental Hygiene in Education," with Garry C. Myers as chairman, brought an interested audience. Two short papers were presented, followed by a long period of discussion. W. Carson Ryan presented many concrete illustrations of the functions of mental hygiene in the school and classroom situation growing out of his studies in this field.

In a session devoted to "New Developments in Education," George D. Stoddard, vice-president of the section, read a report, prepared by Henry W. Holmes, of a special committee of the American Council on Education whose task it is to evaluate educational research in certain areas.

At the joint dinner with the Section on Psychology (I), there was a large and appreciative attendance. The sections were honored by having present Dr. J. McKeen Cattell, past president of the American Association for the Advancement of Science, Dr. Otis W. Caldwell, general secretary, Dr. Yerkes, of Yale University, and Dr. Woodworth, of Columbia University. The vice-presidential address of the retiring vice-president of Section I, Calvin Stone, of Stanford University, was on "Individual Differences as Points of Departure for Research in Animal Psychology." Dr. Stone reviewed tellingly some of the more striking investigations of individual differences in animal abilities. The address of the retiring vice-president of the Section on Education (Q), Ralph W. Tyler, dean of the School of Education of the University of Chicago, was on "Basic Considerations in the Improvement of Educational Tests." Dr. Tyler reviewed the work of the Committee on Evaluation of the Commission on Secondary Schools of the Progressive Education Association. Dr. Tyler discussed some of the new testing procedures which have been developed.

AMERICAN NATURE STUDY SOCIETY AND OTHER ORGANIZATIONS

(*From report by Nellie F. Matlock*)

The celebration of the society's thirtieth anniversary provided an added impetus for an invigorating program.

Reports were made by former presidents of the society, the outstanding one being that of Liberty Hyde Bailey, its first president, who charmed every one with reminiscences of his long and eventful life.

F. R. Moulton delivered a brief talk on "Radio Education." He was followed by C. L. Fenton, who gave a comprehensive discussion of nature books and the goals. Miss Mary Leeper, executive secretary of the Association for Childhood Education, told of her work with the association in the promoting of science education. W. C. Croxton led a discussion on the problems of nature study.

On Thursday morning the American Science Teachers Association held a session, with W. L. Eikenberry presiding, at which papers were presented by Harlan T. Stetson, Philip R. White and Charles S. Piggot. At the luncheon which followed Otis W. Caldwell presided and Wesley C. Mitchell, president of the association, spoke. At an afternoon session, presided over by Harry A. Carpenter, papers were read by Jerome Isenbarger, Hanor A. Webb and Karl F. Oerlein.

Gamma Alpha Graduate Scientific Fraternity, Sigma Delta Epsilon Graduate Women's Fraternity and Pi Gamma Mu, National Social Science Society, also held business meetings and luncheons in Richmond during the meeting of the association.

The Catholic Round Table of Science held a luncheon on Tuesday, at which "Promoting Research: Its Regional, National, and International Applications" was discussed.

The Union of American Biological Societies held a session on Wednesday afternoon at which important reports were presented.

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SEISMOLOGY FROM A MATHEMATICAL VIEW-POINT[1]

By Professor W. D. CAIRNS

OBERLIN COLLEGE

The high honor attaching to the office of vice-president of the American Association for the Advancement of Science demands a worthy effort on an occasion like the present. Very properly a general consideration of some field within the scope of mathematics may come under review, and all the more will this be appropriate for a section of the American Association if it links itself to some other department of science. I am therefore returning to an old-time love of mine and considering to-day the advance that has been made in seismology within, let us say, the last thirty years.

At first sight the phenomena to be studied seem hopelessly confused; the ground effects near the origin of the earthquake show buffeting blows from all directions; earthquake records, even those of the same earthquake, often look widely different; and the layman wonders what can be made of these happenings as a science. It is, however, the glory of the human mind that it can select, classify, analyze, and can thus bring order out of chaos.

> The universe is a system, a unit,
> Only in the mind of man.

[The speaker described (1) the evident mechanism of earthquakes consisting of a gradually increasing strain and subsequent fracture of the rock structure; (2) the transmission of the shock, the longitudinal and transverse wave through the earth and a wave of greater amplitude over the surface; (3) various reflected and refracted waves; and (4) methods for obtaining information about velocities below the surface, the depth of the earthquake focus and of various discontinuities below the earth's surface.][2]

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[1] Address of the retiring vice-president and chairman of the Section on Mathematics, American Association for the Advancement of Science, Richmond, December 28, 1938. The address was illustrated by a large number of slides.

Wiechert[3] had by 1907 determined from the three components the angle of emergence of P and S waves where they meet the surface of the earth as a table giving the sine of this angle compared with Δ, the epicentral distance, and had plotted the velocity at the vertex (the deepest point of the path) against the depth of the vertex. He had thus prepared the way for the theoretical treatment made by Herglotz in 1907 and accepted even now as the method for determining the paths of the waves through the earth's interior. Seismologists have always assumed Snell's law that in passing from one medium to another of a different density the angles of incidence and refraction are connected with the velocities in the two media by the relation $\sin i_1/\sin i_2 = v_1/v_2$. Fermat's principle that a wave travels from one point to another in the least possible time, and an assumed law of dependence of velocity on depth, will determine the path, the travel-time in terms of epicentral distance, etc. Happily Herglotz recognized that conversely, with a few natural assumptions such as an increase of velocity with depth, the data furnished by a travel-time curve give a unique solution for the paths of the waves and for such incidental relations as that between the maximum velocity and the depth of the vertex. For those sufficiently conversant with mathematics, it may be said that Herglotz[4] in February, 1907, recognized Benndorf's[5] formulation of May, 1906, as an integral equation of the form

$$\Delta = \frac{2R}{V_\Delta}\int_{x=a}^{x=b} \frac{d \log r}{(x-a)^{1/2}},$$

R earth's radius; r radius to a point of the path; $x = 1/V_r^2$; $a = 1/V_\Delta^2$; $b = 1/\bar{v}^2$; v_r vel. at the point of the path; $V_r = \frac{v_r R}{r}$; $\bar{v}$ vel. of wave as it emerges at earth's surface; V_Δ component of $\bar{v}$ along earth's surface. Herglotz gave as its solution:

$$\log R/r_v = -\frac{1}{2\pi R}\int_b^x \frac{V_\Delta \Delta da}{(a-x)^{1/2}},$$

r_v radius of vertex; and Wiechert[6] in 1910 simplified it thus:

$$\log R/r_v = \frac{1}{\pi R}\int_0^\Delta q d\Delta,$$

$\cosh q = V_r/V_\Delta$.

The computation, which by this formula gives the radius of the vertex of any path in terms of the epicentral distance, as well as the velocity at the vertex, depends essentially on an estimation of the slope of an accurate travel-time curve at various points and on a graphical integration. While the method now used is precisely that of 1910, the improvement in the reliability of records and in technical ability to interpret these records has enabled seismologists within the past ten years to utilize a greatly increased mass of records and to obtain results far more reliable than formerly.

Numerous ingenious methods have been developed for the determination of deep foci. These all depend on the fact that the travel-time curve of any phase varies somewhat with the depth of the focus, as Scrase[7] in 1931 indicated in his P and S curves drawn for several different focal depths Brunner[8] draws the P curve for an earthquake occurring at the surface, a curve slightly lower than this for the corresponding P wave if the depth of the focus were 100 km, a curve slightly higher than the first for the wave pP reflected from the earth near the epicenter for a focal depth of 100 km, with similar pairs of curves for 200 km, 300 km, . . . 700 km and a similar set of curves for S and some other phases. If then, as in the illustration which was shown, the pP, S and sS phases occur later than the P phase by 1 min. 15 sec., 10 min. 18 sec., and 12 min. 43 sec., these are marked on a straight strip of paper according to the time scale and the strip is fitted uniquely to the Brunner chart, indicating in this special case an epicentral distance of 90°, a depth of approximately 340 km and the additional fact that the earthquake originated 12 min. 24 sec. before the time of arrival of the P phase. Depths up to 700 km have been determined for both light and heavy earthquakes.

From the information available in 1926 Daly[9] inferred that heavy shocks originate at depths less than 25 miles and that the occasional shock at depths greater than 40 miles may mean that the material below that depth is of the nature of hot glass and not crystalline rock. Such conclusions as to the composition of the earth have been based on a questionable extrapolation; but these conclusions have been gradually revised because of data that give much fuller information as to the depth of strong and weak shocks, and they can now be modified much more reliably by reason of such heavy-pressure work as that of Bridgman through the attainment of laboratory pressures of 50,000 atmospheres or approximately 50,000 kg/cm² corresponding to a depth of perhaps 160 km if we make a reasonable assumption of density.

The dependability of records from good instruments is unquestioned, as is evidenced by almost identical seismograms of the same shock on instruments of similar instrumental constants used at the same station or of similar instruments in the same general region. There has been a decided gain in the clearness of records and in the greater control over a wider range of magnification.

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[2] For discussion of these points see, *e.g.*, Macelwane, "Theoretical Seismology," New York, 1936.

[3] E. Wiechert, Gött. Nachr., math.-phys. Kl., 1907.

[4] G. Herglotz, *Phys. Zeitschr.*, 8: 145–147, 1907.

[5] H. Benndorf, *Mitt. d. Erdbeben Komm.*, 29, 1905; 31, 1906; *Sitzungsber.*, 114, 1905; 115, 1906.

[6] E. Wiechert, *Phys. Zeitschr.*, 11: 302, 1910.

[7] F. J. Scrase, *Proc. Roy. Soc.*, A, 132, 1931.

[8] G. J. Brunner, "Earthquake Notes," Eastern Sec., Seism. Soc. of Amer., 1934.

[9] R. A. Daly, "Our Mobile Earth," pp. 116, 119, New York, 1926.

This discussion divides itself as between theory and practice; and it becomes manifest at once that the applicability of seismological theory depends on the advance made in observational instruments and methods and in their trustworthiness.

SEISMOMETERS

It is probably well known that a seismometer consists of a so-called "steady mass" suspended delicately through a flat spring or a pivot on a framework which is rigidly attached to the ground, preferably to solid rock. It is suspended so as to move freely, say, east and west; a compressional wave coming from the west will displace the ground and framework toward the east, but the steady mass will lag on account of its inertia and will therefore appear to move toward the west, its relative motion being magnified by mechanical means and recorded on a roll of smoked paper as in the Milne and Wiechert types, or magnified by galvanometric means and recorded photographically as in the more recent types. To furnish a record at a really complete station it is necessary to have three instruments to register the vertical, the north-south and the east-west motions, respectively, as well as to record waves of both short and long periods.

(The speaker here described the leading types, contrasting the older and newer instruments.)

Much intensive work has been done in California the past six years in the study of near-by earthquakes by means of "accelerometers," *i.e.*, instruments which are designed to register not displacements or velocities but accelerations. Lack of time prevents any discussion of this study, which is so important in relation to construction that shall withstand earthquake shocks and in furnishing data for the mathematical treatment of disturbances close to the epicenter. Nor can attention be given here to the great progress being made in the seismological exploration for oil deposits, or to the study of microseismic movements which obscure the records in varying degrees and which have yet to be correlated successfully with meteorological or other phenomena, even after thirty-five years of research.

INTERPRETATION OF RECORDS

An amazing amount of highly creditable investigation has been given during the past thirty years to the mapping out of various "phases" of earthquake waves. This involves the determination of the exact time at which a sharp change in the record takes place, and exceedingly critical examination and comparison of many records of the same earthquake and of similar earthquakes so as to establish a definite continuity in the progress of this suspected phase as the epicentral distance increases. The travel-time curves of such phases and the accumulated evidence of velocities at varying depths below the earth's surface throw light on the probable path through the earth. In particular, the very complete analysis by Jeffreys[10] in forming his travel-time tables shows a high grade of mathematical work, as measured by the very small standard errors of his results; its dependability is limited only by his data, since he, like others, made an arbitrary but judicious choice from the available earthquake records. To be sure, seismologists, like our national economists to-day, sometimes form consistent and well-authenticated theories, which fail, however, to agree with those of other equally qualified experts; nevertheless, there is a gratifying agreement as to the real existence and travel-time of the more important phases, along with a great improvement in the time control and accuracy of time determinations.

AN APPRAISAL OF THE FIELD

Numerous attempts have been made to apply harmonic analysis to the study of seismograms either on account of the quasi-periodic character of the curves or on an assumption of periodic motion of the earth for a short interval. (Slides were shown of two complex curves not entirely dissimilar: one of a seismogram imitated quite closely years ago by Professor D. C. Miller by the combination of thirty harmonic curves, another as the combination of ten harmonic curves, also by Professor Miller; the second was, however, not a seismogram but the note of a clarinet!) The fallacy in this sort of analysis is that the theory of harmonic or Fourier series analysis resolves a curve uniquely into harmonic constituents only where there is a periodic motion, ever so complicated, perhaps, but with a definite and sustained period. About all that has been done along this line is for an expert seismographer to sketch a curve through a complicated seismogram which evidently shows a wave of longer period and of large amplitude, superposed on which are smaller waves of shorter period. The instant reaction of the mathematician to this procedure, however, is that if such a curve is legitimate in practical interpretation; *i.e.*, if there is actually a wave of this character, some mathematical theory should be developed which will correspond to this postulated reality. While several have presented criteria for the existence of such a periodic wave, the science of seismology is still very much undeveloped at this point.

One line of evidence on which any theoretical interpretation must be based is the amount of displacement of the ground at any station and hence its frequency or possible periodicity, its amplitude, etc., as inferred from the records of its three components. These curves are quite unlike. The usual formula for a damped pendulum whose support is disturbed by a blow, or by a sustained motion of the earth, furnishes theoretically the relation between the displacement on the seismograph record and the ground displacement, both for mechanical and for galvanometric registration. Formulas for these two leading types of seismometers are exhibited here:

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[10] H. Jeffreys, *Beitr. d. Geophysik*, 1936; Mo. Notices, Roy. Astr. Soc., Geophys. Suppl., 4, 1937–1938.

Equation of mechanical photographic seismometer:

$$V\frac{d^2x}{dt^2}=\frac{d^2a}{dt^2}+2\varepsilon\frac{da}{dt}+\left(\frac{2\pi}{T_0}\right)^2 a.$$

x is ground displacement; a is record displacement; ε is damping factor; T_0 is natural period of pendulum; V is magnification for very short waves. The solution is given by

$$Vx=a+2\varepsilon\int_{t_0}^{t}a\,dt+\left(\frac{2\pi}{T_0}\right)^2\int_{t_0}^{t}dt\int_{t_0}^{t}a\,dt.$$

From this equation it follows that a seismometer measures displacements, velocities or accelerations of the ground motion according as the period of a wave is much less than T_0, intermediate in value, or much greater than T_0. Both graphs and nomograms are available for finding the magnification, whether the record indicates an obvious period or only an impulse.

Equations of galvanometric seismometer:

$$K\frac{d^2\phi}{dt^2}+D\frac{d\phi}{dt}+U\phi=ML\frac{d^2x}{dt^2}-Gi$$
$$k\frac{d^2\theta}{dt^2}+d\frac{d\theta}{dt}+u\theta=gi$$

x = ground displacement; ϕ = angular displacement of steady mass; θ = angular displacement of galvanometer coil; i = current intensity. From these is derived a rather complicated expression for magnification.

Since any disturbance is ordinarily damped out on the record within half a vibration, it is theoretically possible, on each of the three components, to take account of the manner in which magnification depends on the period of the wave at any instant and to draw a record of the actual displacement of the ground through mechanical or graphical integration and thus by comparing the three components to know, for example, whether the wave at any moment is longitudinal, transverse or screw-like, whether it occurs in a horizontal or vertical or oblique plane or in no plane, whether it is a periodic motion continuing for several seconds or for a few minutes, *i.e.*, whether the earth in any limited region has a so-called "proper motion," or whether, on the other hand, there appears to be no analyzable motion aside from the leading phases already mentioned. Here is where, in my judgment, a proper advance has not been made in the past thirty years. Even conceding that promising trials have been made by Gutenberg, Sharpe and others, we must have in mind that Wiechert began this as early as February, 1901. There should even at the present day be closer agreement and greater dependability in the calculation of ground displacement and ground motions. For example, Sharpe interprets the same record by two different methods as giving at one instant displacement measurements so diverse as 93 μ and 63 μ at a distance of 72°.6, 62.4 μ and 30.1 μ at 77°.5, etc., although he has much closer agreement from 80° on. Moreover, within the past two or three years doubt has been thrown[11] on the formulas used in the Galitzin-Wilip and other types, the observed magnification being in some instances 50 per cent. larger than the theoretical, probably because of the reaction of the coil of the galvanometer on the motion of the steady mass. If a more critical study than has yet been made of this whole class of trials throws doubt on the validity or applicability of the formulas taken from mathematical physics, it is of prime importance that scholars highly qualified in applied mathematics should correct the older methods or develop new and correct ones. It is also undoubtedly true, as more than one careful observer has said, that too much of routine station work is unreliable except for the good indication of times of arrival of the various phases. Only 20 per cent. of the records which Sharpe[12] collected were usable for ground motion study, and a similar criticism was made in 1936 by Gutenberg and Richter.[13] Much more than is now the case should instruments be kept in adjustment, the records and the instrumental constants be uniformly well taken so that onsets, amplitudes, periods may be obtained reliably.

The first P phase and its immediate successors are more readily studied than the S or L phases because they are less overlaid and hidden by waves already on the record. There are, however, many accurate records where the S phases enter as measurable impulses and where consequently fairly definite conclusions should have been made as to the nature of these waves. It appears to me, after a careful study, that the most that has been accomplished in the past thirty years is agreement that the S phases are approximately transverse, usually polarized, *i.e.*, vibrating in a plane, but that this is only a rough first approximation. For example, to suggest the complexity of the situation, Macelwane shows an S phase which appears first as a westward impulse, then as a southward impulse and then (approximately nine seconds later) as an upward impulse with a similar condition in the next two or three half-oscillations; hence this must be more nearly a helical motion, the energy vector pointing first upward, then eastward, etc.

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[11] Wenner and McComb, *Bull. Seism. Soc. of Amer.*, 26, 1936.

[12] J. A. Sharpe, *Bull. Seism. Soc. of Amer.*, 25, 1935.

[13] Gutenberg and Richter, *Beitr. d. Geophysik*, 47, 1936.

It is worth while noting that several seismologists have collected and analyzed data which convince them that the core of the earth does transmit transverse waves, a conclusion which, if well founded, will modify interpretations as to the earth's interior.

With regard to the *L* or surface waves, it is only fair, in a critical review such as this, to say that these are the most difficult to measure for the reasons that much is happening on the record already, that surface waves are less uniform due to the heterogeneity of the geological surface structure and that the trace frequently runs off the record or onto adjacent lines of the record. In the same breath I feel impelled to say that remarkable progress has been made during these years in the deciphering of complex records and in the recognition of various *L* phases, and that more might have been expected in determining the nature of these waves.

Rayleigh long ago showed the mathematical possibility of surface waves whose intensity decreased rapidly with the distance below the surface, a sort of skin effect, the energy of which decreased inversely as the square, rather than the cube, of the epicentral distance. But in this type of wave a particle on the surface would vibrate with a retrograde movement in an ellipse elongated *vertically* in a plane passing through the path of the wave while the observed motion is much more commonly in an ellipse elongated *horizontally* and has a strong component at right angles to the path. A second type of surface wave, the Love wave, has a sound mathematical basis, but serves only incompletely to correspond to the waves which it was supposed to represent. Whether other types mathematically possible can be found that will conform to the observed types or whether some more general, and unfortunately more complicated, theory must be used, there is here a large field for the highest kind of research. I think I am correct in saying that, except for Uller's[14] theory and perhaps Sezawa's or Gutenberg and Richter's, very little of worth has been done on the theory of earthquake waves in the past thirty years. My own prediction is that the simple elasticity theory in use almost unchanged for the past fifty years of the history of seismology must be modified along the line of what in optics is called the theory of dispersion or possibly by the use of a theory somewhat like that now employed in atomic theory. Gutenberg said in 1935: "Recent investigations have shown that in most regions—perhaps everywhere—we do not have one homogeneous surface layer, but a few with slightly different properties, and that, besides, the thickness of these layers and even their properties are different in different regions. . . . It seems to be probable that differences found by different authors are due more to the use of different earthquakes than to differences in the methods used by them." In some details we must expect each earthquake to give its own characteristic record and even each station to have its own individual record of each earthquake. Much attention should be given in the immediate future to comparing the records of specific stations with the accepted "average" curves so as to identity as much as possible the variant characteristics of each station, in the hope of ascertaining the variations in local structure.

One greatly contested question is whether the period of seismic waves is independent of distance or whether, on the contrary, the irregular waves tend to smooth out, just as when an object is thrown into water. Gutenberg, Galitzin and others have in the past adduced evidence that there is no change of period with distance, but in 1923 Macelwane[15] from the records of 66 stations pointed out that both short and long *P* waves tend to approach a uniform prevailing period. Gutenberg in 1934–35 found that for all types of curves the prevailing period at a station increases as the station distance increases. In my opinion, there is a sufficiently large supply of trustworthy records so that this could be definitely decided by two or three experts, criticizing each other's findings. The classical theory of elasticity takes no account of possible change of period. But this is a question of prime importance in seismological theory; if there be such a progressive change, due to viscosity or other cause, some able mathematical physicist must develop a suitable theory.

If, as I believe after a consideration of the evidence concerning waves through the deeper parts of the earth's interior, we include in our study what are undoubtedly variations in their behavior at these depths also, and if we accept the usual postulate that a shock is transmitted from a focus to a distant point in the least possible time, we must conclude that the major portion of an impulse, as measured by intensity, amplitude, acceleration or other mathematical characteristics, will go from one point to another along such paths as are now accepted, but that, because of variations in structure along these paths, a minor part will be scattered over paths which differ slightly from the main path and will differ more or less from the main phase in time and direction of arrival and will show smaller amplitudes and intensity and slight differences in phase, period, etc. Thus a phase will appear on a record as a rather sharp change or impulse, but surrounded by small variations which, so to speak, cluster somewhat irregularly about the main impulse. It is analogous to the appearance of a point of light which appears through clear glass as a point but through slightly ground glass as somewhat diffused owing to the small irregularities caused by the grinding. Whether these variations will be amenable to such successful treatment as, for example, the statistical study of travel-time curves by Jeffreys, must be answered according to our states of mind, ranging, in Gutenberg's facetious phrase, from his own optimism to Macelwane's pessimism!

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[14] K. Uller, *Beitr. d. Geophysik*, 18, 1927 and later vols.

[15] J. B. Macelwane, *Bull. Seism. Soc. of Amer.*, 13, 1923.

The whole subject of seismology is complex, somewhat as the field of economic or sociological phenomena; it grows out of and depends on a variety of superposed causes and elements and is therefore especially difficult of analysis. In its applications to seismology, mathematics must examine not merely its validity but its sufficiency, for in this field its sufficiency *is* the measure of its validity. In closing, we can only join with the Countess in "All's Well that Ends Well":

> Will your answer serve fit to all questions?
>
> . . . .
>
> It must be an answer of most monstrous
> size that must fit all demands.

OBITUARY

CALVIN BLACKMAN BRIDGES

THE death of Calvin Blackman Bridges on December 27, 1938, is a serious less to genetics and also a personal loss to his many friends. Taking part from the beginning in the *Drosophila* investigations that started at Columbia University about 1910, he became, after obtaining his doctorate, a member of the small group supported by a grant from the Carnegie Institution of Washington. He was still a member of the staff at the time of his death. During these twenty-five years Bridges made a long series of contributions that won him wide recognition as an outstanding genetic investigator.

He was born in 1889, at Schuyler Falls, New York State, and his early years were passed near Plattsburg, N. Y. Beginning as an undergraduate at Columbia he was my private assistant from 1910 to 1915, and fellow 1915–16, taking his Ph.D. in 1916. As stated above he was a member of the "Carnegie Group" 1915–38. In 1936 he was elected to the National Academy of Sciences.

A bare list of the titles of his papers from 1913 to 1938 would give some idea of the nature of the many contributions he has made. His paper on non-disjunction has become a classic; it adduced convincing evidence that chromosome movements furnish the mechanism of heredity. This evidence rested both on observational work and genetic experiment. What seemed at first an exception to accepted genetic interpretations turned out a brilliant confirmation of them—the exception that proved the rule.

Bridges' early discovery (1917) that certain genetic data could be interpreted as due to deficiencies in the chromosome-construction has led in recent years to a factual demonstration of such deficiencies. In some of his latest work (1937–38) he made use of this discovery in the interpretation of overlapping deficiencies to demonstrate the characteristics of certain mutant types. It would be hard to find in the history of genetic research a more convincing demonstration of the combination of factual evidence and masterly interpretation of it. As early as 1919 Bridges described "duplication" as a chromosomal aberration, and here, as in his other work, his conclusions rested not on guessing or vague hypotheses but on experimental proof. Much later he also reported the occurrence of "repeats" in the normal chromosome which will have to be seriously considered in future interpretations of certain types of genetic behavior.

His work on sex determination was a brilliant venture into a more theoretical field, although here, too, it is important to observe that there was no idle flight of speculation but an adherence to actual evidence based on his own thoroughgoing observations. His interpretation of the effects of tetraploïdy, triploidy, haploidy on the constitution of the individual is an outstanding contribution to the theory of sex determination in such forms as *Drosophila,* where the outcome is not complicated by the presence of sex hormones in the conventional use of this expression. This work led him to a theory of gene balance that applies not only to problems of sex determination but more broadly to gene balance involving the physiology of phenotypic expression. His interpretations of balance in sex determination in particular inclined him to believe that it is unwise, *i.e.,* not in accord with the evidence at hand, to look for a male-producing and a female-producing gene, this being too naïve a way of expressing the facts, which are more probably due to balance of many kinds of genes more or less widely distributed in the chromosomes. This does not mean that some genes may not be more influential than others in regulating the development of one or the other sex, which may well be the case, but the search for genes concerned only with sex has up to the present not been successful.

In recent years Bridges has spent much time in revising the genetic maps which are the standard ones wherever *Drosophila* is used. His work here was more than a routine job, for he devised ingenious methods to meet some of the statistical problems involved. The discovery of the large striated chromosomes of the cells of the Malpighian tubes and of the salivary glands of Dipteran larvae by Heitz and Bauer and by Painter in 1933 opened the way for demonstrating some of the earlier conclusions reached by genetic analysis. They pointed out the constancy in the seriation of the banding along these chromosomes, and Painter emphasized the point to point apposition of the two homologous strands. He also went further and demonstrated the identity of particular sections of the salivary chromosomes with particular sections of the genetic map by utilizing the available materials for translocations, deficiencies and inversions. Bridges (1935) then made an elaborate study of the salivary chromosomes, and his more recent work has more than doubled the number of visible bands. These maps bid fair to become the standard ones for *D. melanogaster*. It should be pointed out that the identification of the salivary bands with the genetic map would not have been possible were it not that during the preceding twenty-three years the genetic maps had been built up to a point where such comparisons had a real, demonstrable basis. While many workers had contributed to bring the genetic maps to their status in 1933 it was Bridges in particular who had made a more detailed and critical study of the maps than had any single one of his contemporaries. It is generally recognized that the building up of stocks, containing efficient combinations of genes suitable for special genetic problems, was carried out by Bridges. Any one who is familiar with the labor and ingenuity involved in making such combinations will realize what a very great assistance Bridges has given to the workers in this field.

In the course of the 25 years that the map-making has been going on, more than 900 stocks have been constructed that are invaluable for the pursuit of many genetic problems. There is no other material comparable with this, and to-day the "Carnegie Group" is faced with the responsibility of maintaining these cultures, each of which is carried in three-fold for safety. This work involves most careful supervision to insure the purity of the material; for experience has only too well shown that if not carefully watched the stocks may deteriorate. These stocks are available to-day for research work anywhere in the world and have been widely used.

Since 1934 Bridges and Demerec have printed for private distribution (under the auspices of the Carnegie Institution of Washington) nine large volumes called "Drosophila Information Service" that bring together the vast amount of work in this field up to date. This undertaking was arduous in the extreme, and I am afraid it overtaxed Bridges and diverted him to some extent from his more important pioneering work. He has left behind a very large amount of unpublished data. Fortunately the requirements of the Carnegie grant were such that each year a report of progress had to be made (see Reports Nos. 15–37). In consequence the twenty-three reports give in briefest summary the results that Bridges had obtained. Whether the elaborate data, that are on file, on which these reports rest, can ever be fully utilized is questionable; but Bridges accomplished so much other work they will not be needed to place him amongst the leading geneticists of his time.

T. H. MORGAN

HENRY VAN PETERS WILSON

HENRY VAN PETERS WILSON, Kenan professor of zoology in the University of North Carolina, died in Duke Hospital, Durham, N. C., on January 4, 1939, and was buried at Chapel Hill on January 6, a few weeks prior to his seventy-sixth birthday. He was born in Baltimore, Maryland, on February 16, 1863, and was a son of the Reverend Samuel A. Wilson and Sophia Anne Stansbury Wilson.

Professor Wilson was educated in the schools of Baltimore and Johns Hopkins University. Following graduation from Hopkins in 1883, he was registered for a short time in the Medical School of the University of Maryland, but soon found that his interests were primarily in biological science rather than in clinical medicine. He transferred to the graduate school of Johns Hopkins and began work in zoology under Professor W. K. Brooks, who at that time was drawing into his laboratory a number of able young men. Under the inspiring tutelage of Professor Brooks, and in company with these eager fellow students, many of whom have since added luster to American science, H. V. Wilson worked for a number of years. He received the degree of doctor of philosophy in 1888 and continued at Hopkins as Bruce fellow until 1889. From 1889 to 1901 he worked at Woods Hole in the laboratory of the U. S. Fish Commission.

In 1891 Dr. Wilson, then a young man of twenty-eight, went to the University of North Carolina as professor of biology. With the separation of the departments of botany and zoology in 1904 he became professor of zoology, and he continued as head of that department until 1936. He became Kenan professor of zoology in 1917. At Chapel Hill Professor Wilson soon came to be recognized as a critical and inspiring teacher. Severe discipline and rigorous thinking became outstanding characteristics of his department. His insistence on thorough scholarship and his enthusiasm for research, shared by a number of his young colleagues, were important influences in laying the foundation for a tradition of creative scholarship in what was then a small isolated institution with an honorable history but suffering from the post-war poverty of the South. This enthusiasm for research and for building up the facilities for research caused him to exert his influence towards the establishment of the U. S. Fisheries Laboratory at Beaufort, N. C., and he served as director of it from 1898 to 1901. This laboratory was always near to his heart, and he spent many happy summers there engaged in the investigation of problems of marine biology.

Throughout his long productive life he was nearly always working but never hurried. Despite a heavy load of teaching and administrative duties, his research accomplishments are impressive. He was one of the foremost authorities of the world in the classification of the sponges, and some of his papers in other fields are classical. It is appropriate to mention here his work on the embryology of the sponges, coelenterates and lower vertebrates and his dramatic and widely known work on the regeneration of sponges and coelenterates from dissociated cells. Just a few months before his death he reported to the National Academy of Sciences his final fundamental research dealing with the participation of vacuoles in the formation of cell membranes.

Dr. Wilson's qualities of character and mind made him a vivid and forceful personality and a delightful and stimulating companion in his hours of relaxation. Simple in his habits, inherently and inescapably honest, he had no patience with pretense or complacency. His opinions and criticisms were searching and straightforward, sometimes to the point of sharpness, but, being kindly and tolerant by nature, he gained not only the respect but the affection and devotion of all those who knew him well. Although primarily a biologist, his intellectual interests were far-ranging. The writer, who was closely associated with him for several years, recalls with a feeling of stimulation and pleasure how his incisive mind would cut through the superficialities investing any subject and how his comments would illuminate a wide variety of topics.

Although he was not aggressive for publicity and honors, Dr. Wilson's merit was recognized by his fellow biologists throughout the world. He served as president of the American Society of Zoologists and was a member of the National Academy of Sciences, American Philosophical Society, American Society of Naturalists, Boston Society of Natural History, Société Linnéene de Lyon, etc.

In 1893 he married Edith Theresa Stickney, of Boston. He is survived by two daughters, Mrs. Thorndike Saville, of New York City, and Mrs. Howell Peacock, of Philadelphia, and by one son, Dr. H. V. Wilson, Jr., of Dover, Delaware.

W. C. GEORGE

RECENT DEATHS AND MEMORIALS

DR. ALBERT SAUVEUR, emeritus professor of metallurgy and metallography at Harvard University, died on January 26 at the age of seventy-five years.

PROFESSOR JOHN HENRY SCHAFFNER, since 1911 professor of botany at the Ohio State University, with which he had been associated since 1897, died on January 27 at the age of seventy-two years.

DR. EDWARD SAPIR, since 1931 professor of anthropology and linguistics at Yale University, died on February 4 at the age of fifty-five years.

DR. GEORGE H. GIRTY, geologist and paleontologist of the U. S. Geological Survey, a specialist on carboniferous formations and faunas, died on January 27. He was sixty-nine years of age.

PROFESSOR RALPH CLEMENT BRYANT, a member of the faculty of the Yale School of Forestry, since 1911 as professor of lumbering, died on February 1 at the age of sixty-two years.

ARTHUR N. LEEDS, research associate in botany at the Philadelphia Academy of Natural Sciences, died on January 26 at the age of sixty-eight years.

EDGAR HERBERT WELLS, since 1921 president of the New Mexico School of Mines at Socorro, N. M., committed suicide on January 8. He was fifty-one years old. Mr. Wells had been professor of geology and mineralogy of the college from 1917 to 1925 and state geologist from 1925 to 1927.

FORMER associates of the late Dr. T. Wingate Todd, professor of surgery of the School of Medicine of Western Reserve University, who died on December 28, held a memorial service in his honor on January 15. Dr. Elliot C. Cutler, professor of surgery of Harvard University, formerly of Western Reserve University, and the Hon. Harold H. Burton, Mayor of Cleveland, gave the principal addresses.

SCIENTIFIC EVENTS

THE NATIONAL HEALTH PROGRAM

A NATIONAL health program, which would provide for expenditures by 1949 of up to $850,000,000 annually from state and Federal funds, was recommended to President Roosevelt last July by his special Inter-Departmental Committee on Health and Welfare. While the proposal stirred up some opposition in medical circles, the American Medical Association agreed last September with the Inter-Departmental Committee that there is a vital need for an extension of existing medical facilities, and Senator Wagner has prepared a bill calling for an appropriation of $50,000,000.

Money appropriated for the health program would, according to recommendations, be used to:

Pay physicians to care for those too poor to afford medical care; assist existing hospitals and build new ones where needed, particularly in rural areas; establish clinics for quick diagnosis and treatment of disease; encourage vaccination against preventable diseases.

Develop maternal and child welfare facilities, including baby clinics, schools for expectant mothers, visiting nurses and obstetrical care if needed.

Stimulate public health service to control disease through such activities as controlling stream pollution, establishing more efficient quarantines, health instruction for both children and adults and closer inspection of milk and water supplies.

Funds would be allotted to states and communities under restrictions requiring that they do their part in health promotion.

In submitting the program to the Congress on January 23, President Roosevelt sent the following message:

In my annual message to the Congress I referred to problems of health security. I take occasion now to bring this subject specifically to your attention in transmitting the report and recommendations on National Health prepared by the Inter-Departmental Committee to coordinate health and welfare activities.

The health of the people is a public concern; ill health is a major cause of suffering, economic loss and dependency; good health is essential to the security and progress of the nation.

Health needs were studied by the Committee on Economic Security which I appointed in 1934 and certain basic steps were taken by the Congress in the Social Security Act. It was recognized at that time that a comprehensive health program was required as an essential link to our national defenses against individual and social insecurity. Further study, however, seemed necessary at that time to determine ways and means of providing this protection most effectively.

In August, 1935, after the passage of the Social Security Act, I appointed the Inter-Departmental Committee to Coordinate Health and Welfare Activities. Early in 1938, this committee forwarded to me reports prepared by their technical experts. They had reviewed unmet health needs, pointing to the desirability of a National Health Program, and they submitted the outlines of such a program. These reports were impressive. I therefore suggested that a conference be held to bring the findings before representatives of the general public and the medical, public health and allied professions.

More than 200 men and women, representing many walks of life and many parts of our country, came together in Washington last July to consider the technical committee's findings and recommendations and to offer further proposals. There was agreement on two basic points, the existence of serious unmet needs for medical service; and our failure to make full application of the growing powers of medical science to prevent or control disease and disability.

I have been concerned by the evidence of inequalities that exist among the states as to personnel and facilities for health services. There are equally serious inequalities of resources; medical facilities and services in different sections and among different economic groups. These inequalities create handicaps for the parts of our country and the groups of our people which most sorely need the benefits of modern medical science.

The objective of a National Health Program is to make available in all parts of our country and for all groups of our people the scientific knowledge and skill at our command to prevent and care for sickness and disability; to safeguard mothers, infants and children, and to offset through social insurance the loss of earnings among workers who are temporarily or permanently disabled.

The committee does not propose a great expansion of federal health services. It recommends that plans be worked out and administered by states and localities with the assistance of federal grants-in-aid. The aim is a flexible program. The committee points out that while the eventual costs of the proposed program would be considerable, they represent a sound investment which can be expected to wipe out, in the long run, certain costs now borne in the form of relief.

We have reason to derive great satisfaction from the increase in the average length of life in our country and from the improvement in the average levels of health and well-being. Yet these improvements in the averages are cold comfort to the millions of our people whose security in health and survival is still as limited as was that of the nation as a whole fifty years ago.

The average level of health or the average cost of sickness has little meaning for those who now must meet personal catastrophes. To know that a stream is four feet deep on the average is of little help to those who drown in the places where it is ten feet deep. The recommendations of the committee offer a program to bridge that stream by reducing the risks of needless suffering and death, and of costs and dependency, that now overwhelm millions of individual families and sap the resources of the nation.

I recommend the report of the Inter-Departmental Committee for careful study by the Congress. The essence of the program recommended by the committee is federal-state cooperation. Federal legislation necessarily precedes, for it indicates the assistance which may be made available to the states in a cooperative program for the nation's health.

SCIENTIFIC RESEARCH AND THE FEDERAL GOVERNMENT

THE importance of scientific research and the part played in research by the Federal Government were emphasized in a report by the National Resources Committee transmitted to the Congress by President Roosevelt on January 23. The study was directed by a Subcommittee on Research of the Science Committee, consisting of Charles H. Judd, University of Chicago, *chairman;* William F. Ogburn, University of Chicago, and Edwin B. Wilson, Harvard University. Other members of the Science Committee are: Ross G. Harrison, Yale University, chairman, National Research

Council; John C. Merriam, formerly president of the Carnegie Institution; Waldo G. Leland, secretary of the American Council of Learned Societies; Harry A. Millis, University of Chicago; Walter D. Cocking, University of Georgia, and Edward C. Elliott, president of Purdue University.

In his letter of transmittal to the Congress, President Roosevelt wrote:

> The dependence of civilization on science is universally recognized, but the extent of the activities of private and public agencies carrying on scientific inquiry is not generally known.
>
> It is not likely that large numbers of our people have any adequate realization of the services which are being rendered by the executive agencies of the Federal Government through scientific researches in medicine, agriculture, economics, public administration and the other natural and social sciences.
>
> This report indicates the new emphasis in recent years on activities in the social science fields and stresses the need for effective coordination of all agencies engaged in research in order to achieve the solution of many of our more difficult problems.

The report, entitled "Research—A National Resource," the first of a series in this field, was prepared by the Science Committee of the National Resources Committee and covers the relations of the Federal Government to the problem, while later studies will be concerned with research by universities and colleges, by business organizations, by the large industrial laboratories and by state and municipal governments.

The Federal Government, according to the report, spent on research approximately one dollar for each person in the United States during the fiscal year ending June 30, 1937. The $120,000,000 spent in this field, however, represented only about 2 per cent. of the total budget, in contrast to industrial corporations which spend about 4 per cent. of their budgets on research and universities which spend as much as 25 per cent. The number of professional and scientific workers employed by the Federal Government, under the Classification Act, from 1924 to 1937 has doubled.

The seven recommendations are made by the committee as follows:

> 1. That two studies be made to supplement those reported in this volume, one of the advisory committees which now cooperate with federal research agencies and one of research carried on by states and municipalities. The latter study may well enlist the cooperation of the state and regional planning boards.
> 2. That steps be taken to improve the methods of recruiting research workers for governmental service and to provide more effective in-service training for civil employees of the government.
> 3. That research agencies of the government be authorized and encouraged to enter into contracts for the prosecution of research projects with the National Academy of Science, the National Research Council, the Social Science Research Council, the American Council on Education, the American Council of Learned Societies and other recognized research agencies.
> 4. That official recognition and, where necessary, financial support be given by the government to international meetings of scientists, and that American participation in international organizations and projects be encouraged.
> 5. That research within the government and by nongovernmental agencies, which cooperate with the government, be so organized and conducted as to avoid the possibilities of bias through subordination in any way to policy-making and policy-enforcing.
> 6. That research agencies of the government extend the practice of encouraging decentralized research in institutions not directly related to the government and by individuals not in its employ.
> 7. That the interrelations of governmental research agencies be furthered by the organization of central councils along the same lines as those exhibited by the existing national councils of research specialists. These interagency councils would serve to systematize the efforts which are now made by various interbureau committees to coordinate the research activities within the government.

LINCOLN'S BIRTHDAY CELEBRATION FOR DEMOCRACY AND INTELLECTUAL FREEDOM

A LUNCHEON was held at the Columbia University Faculty Club on January 23, under the auspices of the New York City Committee of the Lincoln's Birthday Committee for Democracy and Intellectual Freedom. Professor Franz Boas announced that the national committee, consisting of twenty-eight scientific men from all parts of the country, including two Nobel Prize laureates and twelve members of the National Academy of Sciences, are sponsoring public meetings in metropolitan and college communities throughout the country on Lincoln's birthday on February 12.

It is the purpose of these meetings, which are an outgrowth of the Manifesto on Freedom of Science signed by 1,284 scientific men, to show that workers in science and education are ready to participate actively in the defense of democracy and intellectual freedom.

The master meeting will be held in the grand ballroom of the Waldorf-Astoria Hotel in New York City at 1:30 P.M. on February 12. Secretary of Agriculture Henry A. Wallace will speak on "Racial Theories and the Genetic Basis of Democracy." Arrangements have been made to broadcast the addresses over the Red Network of the National Broadcasting Company. Other speakers will be Professor Harold C. Urey, of Columbia University; Dr. Ordway Tead, president of the New York City Board of Higher Education, and Professor Clyde R. Miller, of Teachers College, Columbia University.

At the University of Pennsylvania Roland Morris, formerly U. S. Ambassador to Japan, will preside. The speakers will include Dr. Edward P. Cheyney, professor of history at the University of Pennsylvania; Dr. Marion Park, president of Bryn Mawr College, and Dr. E. G. Conklin, professor emeritus of zoology, Princeton University, and executive vice-president of the American Philosophical Society. In Boston, Dr. Karl T. Compton, president of the Massachusetts Institute of Technology, will preside at a similar meeting, and at the University of Illinois, the meeting, sponsored by seven members of the National Academy of Sciences, will be presided over by Professor Roger Adams.

Plans are under way for meetings at the University of California, Stanford University, the University of Wisconsin, the University of Nebraska, the University of Oklahoma, Purdue University, the University of Kentucky, Miami University, the University of Virginia, Duke University, Connecticut State College, Dartmouth College, Syracuse University, the University of Pittsburgh and other institutions.

THE SECOND ANNUAL WILLIAM LOWELL PUTNAM MATHEMATICAL COMPETITION

PROFESSOR W. D. CAIRNS, secretary of the Mathematical Association of America, announces that the second annual William Lowell Putnam Mathematical Competition will be held on March 4, 1939. This competition was held for the first time last April, and aroused much interest among colleges and universities in the United States and Canada, sixty-seven of which entered one hundred and sixty-three competitors. At that time the University of Toronto won the $500 first prize, with the University of California and Columbia University winning the $300 second and $200 third prizes, respectively. Individual winners were scattered over the continent and were about evenly divided between colleges and universities.

Colleges and universities may enter teams of three or individual contestants; applications may be secured from the Secretary of the Mathematical Association of America and must be filed with him by February 15, 1939.

The competition consists of two three-hour examinations, constructed to test originality as well as technical competence. Questions will be taken from the fields of calculus (with applications to geometry and mechanics), higher algebra, elementary differential equations and geometry.

The first prize is $500 to the department of mathematics with the winning team; second and third prizes are $300 and $200, respectively. Each member of the three winning teams receives $50, $30 or $20 according to the standing of his team.

Each of the five highest-ranking individuals receives a prize of $50, and from this group is selected the one to receive the $1,000 William Lowell Putnam Prize Scholarship at Harvard University (or Radcliffe College, if the winner is a woman). Medals also are awarded to the five highest-ranking individuals as well as to the members of the three winning teams.

Honorable mention will be given this year to the three departments whose teams rank next after the winning three and to the five individuals ranking next after the winning five.

The competition, open to undergraduates in colleges and universities of the United States and Canada, is made possible by the trustees of the William Lowell Putnam Intercollegiate Memorial Fund, left by Mrs. Putnam in memory of her husband, a member of the Harvard Class of 1882. It is designed to stimulate a healthful rivalry in undergraduate work in mathematics.

Complete details concerning the rules of the competition will be found in the January, 1938, issue of the *American Mathematical Monthly* and in pamphlets being distributed to colleges and universities in the United States and Canada. All correspondence should be sent to W. D. Cairns, secretary of the Mathematical Association of America, Oberlin, Ohio.

AWARDS OF THE GEOLOGICAL SOCIETY, LONDON

THE Council of the Geological Society, London, has made the following awards:

The Wollaston Medal.—Frank Dawson Adams, emeritus professor of geology and paleontology in McGill University, for his researches on the pre-Cambrian rocks and on the influence of high temperatures and pressures on the properties of rocks at great depths in the earth's crust.

The Murchison Medal.—Harold Jeffreys, M.A., D.Sc., F.R.S., in recognition of the value of his researches on the constitution and physics of the earth's interior, and, in particular, of the deductions he has drawn from the analysis of records of distant earthquakes.

The Lyell Medal.—William Noel Benson, B.A., D.Sc., professor of geology in the University of Otago, N. Z., in recognition of the wide range and excellence of his geological researches, particularly in New Zealand.

The Prestwich Medal.—Samuel Hazzledine Warren, F.G.S., in recognition of his researches on the geology and archeology of East Anglia, particularly of the Lea Valley.

The Bigsby Medal.—Arthur E. Trueman, D.Sc., professor of geology in the University of Glasgow, in recognition of his outstanding contributions to the knowledge of paleontology and stratigraphy, particularly of the coal measures and the lias.

The Wollaston Donation Fund.—Ivan Sydney Double, M.Sc., for his work on the petrology of sedimentary rocks, especially the Tertiary rocks of the East of England, the glacial deposits, the chalk and the trias.

The Murchison Geological Fund.—Arthur Lennox Coulson, D.Sc., in recognition of his geological work in India, especially that concerned with earthquakes and meteorites and the survey of Rajputana.

A Moiety of the Lyell Geological Fund.—William Quarrier Kennedy, D.Sc., for his petrological work, especially in connection with the Tertiary complexes of the Hebrides and the metamorphic rocks of the Western Highlands.

A Second Moiety of the Lyell Fund.—Arthur Raistrick, Ph.D., M.Sc., for his researches on the minute structure and constitution of coal and on the past floras of Britain, as revealed by the study of peats.

SCIENTIFIC NOTES AND NEWS

At a dinner of the Board of Directors of the Research Corporation of New York, held on February 2 at the Faculty Club, Columbia University, awards of $2,500 each for distinguished scientific achievement were made to Dr. Vannevar Bush, president of the Carnegie Institution of Washington, and to Professor Hugh S. Taylor, head of the department of chemistry of Princeton University. The award to Dr. Bush was in recognition of his invention of mathematical computing machines, and that to Dr. Taylor was in recognition of his research in the field of catalysis. The presentations were made by Dean J. W. Barker, of the School of Engineering of Columbia University. Dr. Karl T. Compton, president of the Massachusetts Institute of Technology, introduced Dr. Bush, and Professor Harold C. Urey presented Dr. Taylor.

The 1939 William Freeman Snow Medal of the American Social Hygiene Association has been awarded to Dr. Thomas Parran, surgeon general of the U. S. Public Health Service, "for his great contribution to the health and happiness of the American people through his persistent efforts against syphilis and the conditions which favor its spread." Presentation of the medal was made by Dr. Livingston Farrand as part of the National Social Hygiene Day program at the Hotel Mayflower, Washington, D. C., on February 1. Mrs. Franklin D. Roosevelt and Dr. Parran were the principal speakers.

Miss Alice Eastwood, curator of botany in the California Academy of Sciences since 1892, was guest of honor at a luncheon at the Fairmont Hotel, San Francisco, on the occasion of her eightieth birthday on January 19. A correspondent writes: "The luncheon, attended by more than four hundred persons, partook of the nature of a civic event, and represented a spontaneous expression of admiration and esteem seldom accorded a scientific worker during his lifetime. Felicitations were read from scientific institutions and individual scientists in various parts of the world. Special recognition was given Miss Eastwood's historic action in rescuing the plant types and the records of the academy from the San Francisco disaster of 1906 (*cf.* Science, n.s., vol. 23, p. 834) and her subsequent energetic rebuilding of the herbarium to its present size of over 275,000 specimens. Miss Eastwood engages extensively in field collecting in addition to laboratory and administrative work, and it was pointed out at the luncheon that the growth of the herbarium during 1938, the forty-seventh year of her curatorship, has been the greatest in the history of the academy."

The gold medal of the Royal Astronomical Society, London, has been awarded to M. Bernard Lyot, of the Meudon Observatory, France, for his observations and photography of the solar corona in the absence of a total eclipse.

Dr. F. M. Burnet, of the Walter and Eliza Hall Institute of Research in Pathology and Medicine, Melbourne, has been awarded the Walter Burfitt Prize, 1938, by the council of the Royal Society of New South Wales, for his work on virus diseases in man and animals.

The Academy of Sciences of the U.S.S.R. has awarded the I. P. Pavlov Prize for 1938 to "Honored Worker in Science" I. S. Beritashvili, professor of physiology at Tbilisi University. Professor Beritashvili is the author of works on the physiology of the central nervous system, published in Russian and in other languages.

A Raman Jubilee Volume has been published by the Indian Academy of Sciences to commemorate the fiftieth birthday of Sir C. V. Raman, president of the academy, and the completion of ten years of research on the Raman Effect. The volume contains thirty-eight original papers by distinguished men of science from many countries.

The honorary degree of doctor of engineering was conferred on former President Herbert Hoover at the thirty-sixth annual dinner of the alumni of Stevens Institute of Technology, which was held at the Hotel Astor on February 3.

Professor Griffith C. Evans, of the department of mathematics of the University of California, was elected president of the American Mathematical Society at the recent annual meeting at Williamsburg, Va.

Professor Walter Mulford, head of the department of forestry of the College of Agriculture of the University of California, has been elected a fellow of the Society of American Foresters. There are only eighteen fellows of the society, which has a membership of 4,500.

At the forty-first annual meeting of the Washington Academy of Sciences on January 19, the election of the following officers for 1939 was announced: *President,* Charles E. Chambliss, Bureau of Plant Industry; *Corresponding Secretary,* Nathan R. Smith, Bureau of Plant Industry; *Recording Secretary,* Oscar S. Adams, Coast and Geodetic Survey; *Treasurer,* Henry G. Avers, Coast and Geodetic Survey; *Non-Resident Vice-presidents,* H. S. Graves, Yale School of Forestry, and R. B. Sosman, U. S. Steel Corporation; *Members of the Board of Managers for three years,* J. H. Hibben, Geophysical Laboratory, and G. Steiner, Bureau of Plant Industry; *Member of the Board to fill vacancy for two years,* H. C. Fuller, consulting chemist. *Resident Vice-presidents to represent each Affiliated Society* were elected as follows: Philosophical, F. G. Brickwedde; Anthropological, Henry B. Collins, Jr.; Biological, W. B. Bell; Chemical, B. H. Nicolet; Entomological, Austin H. Clark; National Geographic, Alexander Wetmore; Geological, H. D. Miser; Medical, Fred O. Coe; Historical, Allen C. Clark; Botanical, G. F. Gravatt; Archeological, Aleš Hrdlička; Foresters, W. A. Dayton; Washington Engineers, P. C. Whitney; Electrical Engineers, H. L. Curtis; Mechanical Engineers, H. L. Whittemore; Helminthological, E. W. Price; Bacteriological, L. A. Rogers, Military Engineers, William Bowie; Radio Engineers, J. H. Dellinger.

AT the annual meeting of the Harvey Society, New York City, the following officers were elected for the year 1939–40: *President,* Philip E. Smith; *Vice-president,* Herbert S. Gasser; *Treasurer,* Kenneth Goodner; *Secretary,* Thomas Francis, Jr.; *Council,* Hans T. Clarke, William S. Tillett and N. Chandler Foot.

DR. MOYER SPRINGER FLEISHER, professor of bacteriology and hygiene in the School of Medicine of St. Louis University, has been dismissed from the chair which he has held since 1915. The Rev. Harry B. Crimmins, S.J., president of the university, has stated that Dr. Fleisher had been dismissed because of his sponsorship with others of a lecture on the Spanish war by a Loyalist speaker described as an "unfrocked" priest.

DR. HIPPOLYTE GRUENER, professor of chemistry at Flora Stone Mather College of Western Reserve University, with which he has been connected for forty-three years, retired on February 4.

DR. GEORGE E. UHLENBECK, professor of theoretical physics at the University of Utrecht, who is this year visiting professor of theoretical physics at Columbia University, will return to the University of Michigan as professor of physics, the appointment to take effect at the beginning of the next academic year. Professor Uhlenbeck was a member of the faculty of the University of Michigan from 1927 to 1935.

DR. E. G. PRINGSHEIM, professor of botany at the German University of Prague, has joined the department of botany at Queen Mary College of the University of London. Dr. Pringsheim hopes to transfer to London his collection of pure cultures of algae.

DR. FRED L. MOORE, health officer in Tennessee, has been appointed associate professor in the department of preventive medicine and community health of the Long Island College of Medicine.

AN exchange of professorships for 1939–40 has been arranged between the University of Michigan and the University of Puerto Rico by which Assistant Professor William C. Steere, of the department of botany, will lecture at Puerto Rico and Professor Francisco M. Pagan will lecture at Ann Arbor.

DR. G. D. OSBORNE, of the University of Sydney, has been appointed a research associate at Harvard University. He has left for Cambridge, England, and later will proceed to Harvard to carry out experimental work in structural geology.

AT the annual meeting of the board of trustees of the Field Museum of Natural History, Chicago, Stanley Field was reelected president. He has held the office continually since 1909.

DR. RILEY H. GUTHRIE, chief executive officer of the Boston Psychopathic Hospital, has been appointed first assistant physician at Saint Elizabeths Hospital, Washington, D. C.

DR. RICHARD P. STRONG, professor of tropical medicine emeritus of Harvard University, delivered the Theobald Smith Memorial lecture before the New York Society of Tropical Medicine, which met at Cornell University Medical College, New York City, on January 20. He spoke on "Malarial Diseases in the Western Hemisphere."

DR. EDWARDS A. PARK, professor of pediatrics at the Johns Hopkins University School of Medicine, will deliver the fifth Harvey Society Lecture of the current series at the New York Academy of Medicine on February 16. He will speak on "The Pathology of Rickets with Particular Reference to the Changes at the Cartilage Shaft Junctions of the Growing Bones."

MAJOR GENERAL MERRITTE W. IRELAND, U.S.A., retired, who was surgeon general of the Army during the world war, will deliver the annual William Potter Memorial Lecture at Jefferson Medical College at 8:30 on the evening of Thursday, February 23. The subject of his address will be "Medicine's Debt to the U. S. Army."

DR. P. W. ZIMMERMAN, of the Boyce Thompson Institute, Yonkers, N. Y., gave an illustrated lecture on February 9 before the Lancaster Branch of the American Association for the Advancement of Science entitled "Chemical Secrets in Plant Growth."

SIR JOHN AMBROSE FLEMING, who is now in his ninetieth year, on January 10 addressed the Physical Society, London, on "Physics and Physicists of the Eighteen-seventies." Part of the address was broadcast.

The fourth International Congress of Comparative Pathology will be held in Rome in May, and will consist of three sections devoted respectively to human, veterinary and plant pathology. The subjects for discussion will be ultra-viruses, heredity in pathology, the function of combined antigens and retrogressive processes in plants. The proceedings will open with a reception on May 14 at Hotel Ambasciatori, and will end on May 20. The membership subscription of 250 lire covers the cost of all excursions and entertainments during the congress. The Compagnia Italiana Turismo (C.I.T.), 77, Regent Street, London, W.1, have been appointed travel agents, and will supply full information.

The Council of the British Medical Association will call a national conference on nutrition in relation to national, including agricultural, policy. The dates provisionally selected for the conference are April 27, 28 and 29. In addition to the medical profession the conference will be representative of agricultural producers, home and oversea, as well as of industry and education.

The October meeting of the Physics Club, Chicago, was opened by Professor R. A. Sawyer, who spoke on "The Spectrograph in the Iron and Steel Industry." In November the club acted as host to the American Physical Society, and the joint meeting, attended by about 350 members and guests, was addressed by Bertrand Russell on "Determinism in Physics." On December 20 Dr. Thomas C. Poulter addressed the club on "Extreme Pressures and the Investigation of Engineering Problems," and on January 17 Professor J. W. Beams, of the University of Virginia, spoke on "High Speed Centrifuging and Some of its Applications." The officers for the 1938-39 term are: *President,* Professor B. J. Spence, of Northwestern University; *Vice-president,* Professor J. S. Thompson, of Armour Institute of Technology; *Treasurer,* A. J. Klapperich, Peoples Gas Light and Coke Company; *Secretary,* B. J. Barmack, of the Commonwealth Edison Company. Professor W. S. Huxford, of Northwestern University, is chairman of the Program Committee. The club was organized in 1931 by Professor Arthur H. Compton and Dean H. G. Gale, of the University of Chicago. It has 24 members, mainly teachers, engineers and patent lawyers.

It is announced that requests to the National Research Council Committee for Research in Problems of Sex for aid during the fiscal year beginning July 1, in the study of fundamental problems of sex and reproduction, must be received before April 1. They may be addressed to the chairman, Dr. Robert M. Yerkes, Yale School of Medicine, New Haven, Conn. In addition to a statement of the problem, research plan or program, the committee desires information about the proposed method of attack, the auspices of investigation and the uses to be made of the sum requested. Preference, in accordance with present committee policy, is given to proposals for the study of neurological, psychobiological and behavioral problems.

The University of Maryland has begun the erection of a new building for the medical school at Lombard and Greene Streets. The new building is being constructed with funds left to the university by the late Dr. Frank C. Bressler, an alumnus of the school, and money from the Federal Government. The structure will be known as the Frank C. Bressler Research Laboratory. Each of the five floors of the new building will occupy about 11,000 sq. ft. in addition to a sixth floor which will house the animals for the preclinical and clinical departments of the medical school. The first floor will be devoted to instruction and research in gross anatomy. In addition the Bressler Memorial Room on this floor will be used as a student's lounge. The second floor will house the department of histology and embryology in addition to a large lecture hall. The third floor will be occupied by the department of pharmacology. The fourth floor will be devoted to physiology and the fifth to research in clinical medicine and surgery. The respective departments will contain spacious teaching laboratories and many single, dual and triple research units. Occupancy of the new quarters is anticipated in the winter of 1939.

Dr. S. S. Goldwater, Commissioner of Hospitals, has announced the withdrawal of the Cornell University Medical College from its affiliation with Welfare Hospital. The plan for the organization of the medical staff of Welfare Hospital is essentially unchanged, but instead of three college divisions covering the entire service, there will be two college divisions, to which all nominations will be made by Columbia University College of Physicians and Surgeons and the New York University College of Medicine, respectively, and an Open Division, to which members of the profession generally will be eligible. Dr. Goldwater has appointed Dr. Thomas A. McGoldrick, of Brooklyn, attending physician and director of the Medical Service on the Open Division, and Dr. Condict W. Cutler, of Manhattan, attending surgeon and director of the surgical service on the same division. Dr. McGoldrick is connected with St. Peter's Hospital; Dr. Cutler is a member of the surgical staff of Roosevelt Hospital. On the opening of Welfare Hospital, the Neurological Hospital on Welfare Island will be discontinued, but it is expected that many of the members of the Neurological Hospital staff will be invited to join the staff of Welfare Hospital.

DISCUSSION

THE SPIRAL STRUCTURE OF PROTOPLASM

THERE is now fairly general agreement among certain cytologists that chromosomes or their essential parts, the chromonemata, maintain a spiral structure in all stages. The recent work of Koshy[1] is one example in which this view is maintained.

The writer has investigated the structure of the iron bacterium, *Leptothrix ochracea.* This bacterium was fixed and treated in different ways. It was found that the bacterium is composed of series of longitudinal spirals. Spiral structure has also been observed by the writer in his photomicrographs of fixed preparations of green, filamentous, fresh-water algae.

Five years ago Seifriz[2] stated that the spiral habit seems to be a fundamental heritable quality of protoplasm.

While recently looking through Seifriz's book on protoplasm I was arrested by his photomicrograph[3] of the quiescent protoplasm of a slime mold taken with a Spierer lens under dark-ground illumination. In some parts this picture shows complete spirals. Throughout the remaining parts of the picture structures typical of spirals in optical section are shown. For example, series of short parallel curves arranged one behind the other represent slightly obliquely placed spirals. Series of short, parallel lines arranged one behind the other represent spirals at right angles to the optical axis. A slight thickening at each end of the short lines shows the upward and downward coil in profile and results in slightly dumb-bell-like appearances. When seen end on, the spiral shows a comma-like appearance with the tail of the comma representing the spiral receding in depth. All these appearances are seen in Seifriz's photomicrograph and in the reproduction of it in his book. So it appears that this photomicrograph solves one of the major problems of protoplasm, for it shows the structure of the disperse phase to be spiral in the living state. Through Professor Seifriz's courtesy I have been able to examine the original photomicrograph.

With the spiral structure of Seifriz's photomicrograph as a guide the writer has examined living protoplasm microscopically with ordinary bright-ground illumination and conventional apochromatic lenses. The examination included living cells of stamen hairs of *Rhoeo discolor* and living epidermal cells of the bulb scale of the onion (*Allium cepa*). Spiral structure could be seen in each case. In the onion spiral structure was visible in the nucleus as well as the cytoplasm.

The observations on the spiral structure of protoplasm, which are outlined above, bring the nucleus and the cytoplasm into the same structural class. The disperse phase of the nucleus and of the cytoplasm is evidently spiral in structure.

The remarkable elasticity of protoplasm is explained by its spiral structure. An example of protoplasmic elasticity is given by Scarth.[4] He showed that the nucleus of *Spirogyra* can be pushed by micromanipulation from one end of the cell to the other, but when it is released it immediately recoils to its original position.

The spiral structure of protoplasm can be correlated with several fundamental conceptions of life. One of these conceptions is that of crystalline character. The spiral is fundamentally a crystalline form with a screw-shaped axis. Accordingly, the spiral structure of protoplasm can be regarded as the basis of the crystalline conception of living material.

W. D. FRANCIS

BOTANIC GARDENS,
BRISBANE, AUSTRALIA

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[1] T. K. Koshy, *Annals of Botany,* n.s., 1: 52, 56, 1937.

[2] W. Seifriz, SCIENCE, 77: 50, 1933; 78: 361, 1933.

[3] W. Seifriz, "Protoplasm" (McGraw-Hill), fig. 119, 1936.

[4] G. W. Scarth, *Protoplasma,* 2: 194, 1927.

THE STING OF THE ANT, PARAPONERA CLAVATA

IN an article, "The Sting of an Ant,"[1] I gave the history of the effect of the sting of a worker of the ponerine ant, *Paraponera clavata* Fabr., in British Guiana. The ant stung my knee over the patella through heavy khaki and produced paralyzing symptoms, then a large and persistent blister. The well-founded reputation the sting of this ant has in South America for producing severe systemic symptoms in humans was described.[2]

In discussing the effects of the stings of this species with entomologists and other scientists I was puzzled by accounts of their experiences in Central America, especially Panama. Several persons described being stung by these ants without incurring such severe symptoms as resulted from stings in South America. The stings, however, were always equal to a bad wasp sting. This past summer on Barro Colorado Island in the Panama Canal Zone I was stung by this species[3] and the effect seems worthy of comparison with that previously described. Conditions under which I was stung were comparable, to the extent that both times I was in good health and accustomed to the stings of numerous kinds of ants.

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[1] *Am. Jour. Trop. Med.,* 17: 765–768, Fig. 1, 1937.

[2] In the "Medical Report of the Hamilton Rice Seventh Expedition to the Amazon, in Conjunction with the Department of Tropical Medicine of Harvard University, 1924–25," Harvard University Press, Cambridge Massachusetts, 1926, Dr. J. Bequaert has reviewed (pp. 250–253) the effects of the stings of this ant upon natives and whites in the Amazonian basin. The worker ant is well figured on page 253 (Fig. 8). The reputation this ant has among the natives and the effects of the sting upon whites recorded by Dr. Bequaert are added proof that I was not unusually susceptible or allergic to such poison in British Guiana.

[3] The ant is called "chacha" by the Panamanians and

June 25, 1938, at 2:19 P.M., while excavating the nest of the ant *Sericomyrmex amabalis* Wheeler, I felt a sting comparable to a severe wasp sting on the skin at the junction of the middle and upper third of the left forearm opposite the medial aspect of the biceps muscle. I was wearing a short-sleeved jacket and reflexively brushed the sleeve, whereupon a dealate female *Paraponera clavata* 27 mm. long tumbled to the ground. She had climbed up the sleeve as it momentarily touched the ground and the course of the sting could be followed into the skin as a reddish line 2–3 mm. long on a slight edema resembling that following a mosquito bite. No reaction of the surrounding tissues other than those described above had occurred eight minutes later. At 2:41 an urticarial-like lesion with a central edematous area 2 mm. in diameter and an erythematous halo approximately 40–50 mm. in diameter had appeared.

There was a dull, burning sensation associated with the lesion. By 5:00 P.M. an oval area fully 150 mm long on the inner surface of the forearm was reddened peripherally. A distinctly yellowish edematous area about 100 mm long occupied the center of the reddened area. The burning sensation continued. No systemic reaction was noticed and there was no evidence of lymphangitis extending toward the axilla nor any tenderness or enlargement of the axillary lymph nodes at any time. At 7:30 the lesion was disappearing, though the burning sensation was still present. No medication was applied to the lesion at any time, except that the customary evening shower with soap was taken just before 5:00 P.M. The next morning the area was slightly reddened but not painful. The process gradually disappeared, leaving the arm completely normal.

The effect of this sting of the Panamanian ant strikingly contrasts with that of the Guianan ant previously described. Both belong to the same species and have not been separated, even as different subspecies or varieties, though numerous specimens from both Central and South America have been examined by myrmecologists. The fact that it was a female and not a worker ant which stung me in Panama means that fully as much, if not more, poison was probably injected. Female ants are larger and commonly the sting is more intense than in workers. She had every opportunity to inject a full dose of poison directly into the flesh, while the Guianan worker stung through heavy khaki cloth and was brushed off almost at the time it started to sting. The Panamanian sting, on the medial surface of the forearm, was in an ideal place to be absorbed quickly into the axillary lymph nodes and produce systemic disturbances, while the Guianan sting was over the patella where the blood supply and drainage would be relatively poor.[4] Yet in the Panamanian sting recovery was complete in a few hours; in the Guianan it took over a week.

This difference in virulence of sting in the same species of ant suggests a physiological difference unaccompanied by obvious morphological characters which seems not to have been recorded among ants or related insects.

NEAL A. WEBER

UNIVERSITY OF NORTH DAKOTA,
GRAND FORKS

A REVERSED CRYPTOBRANCHUS

A RECENT article in SCIENCE by Helen A. Wragg on a reversed cat leads to this brief report on the same situation in a large female Cryptobranchus. It was discovered this fall during routine laboratory dissections. As far as can be ascertained, the reversal is complete, with stomach and spleen on the animal's right rather than on its left side. The position of the gall bladder and duodenum has shifted to the left. This condition not only shows itself in the digestive tract, but is obvious in the position of the heart within the pericardial sac, and the relation of the portions of the heart to each other. It is reflected again in the distribution of the intestinal blood vessels. The animal was a perfect specimen and all organs were normal in size and appearance.

IRA B. HANSEN

THE GEORGE WASHINGTON UNIVERSITY

VEGETATIVE REPRODUCTION OF SQUASH TYPES

VEGETATIVE reproduction of squash types, *Cucurbita* spp., has been developed and is now being used to sup-

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is common in the rain forests of this region. Nesting and other habits are essentially similar to those in South America. This species excavates irregular chambers a few centimeters in diameter in the soil at the base of a tree, frequently a buttressed tree. From the nest a soil-covered chimney several centimeters in diameter is usually built to a height of sometimes 10–30 cm. This chimney may be washed down during heavy rains, leaving an opening to the nest occasionally 10 cm in greatest diameter. When their tree is sharply rapped or when the surrounding soil is stamped the ants come "boiling" out and wildly dash about in search for the disturber. Any moving animal in their path is viciously stung. Those ants of a Panamanian nest did not climb trees in their search for a disturber higher than 60 cm, usually about 10 cm. In South America I often found them climbing trees to a height of two meters.

[4] This probably accounts for the localized lesion which resulted compared with the severe systemic disturbance produced by stings in other parts of the body in the usual South American case.

plement sexual reproduction methods in our squash-breeding studies in Puerto Rico. Vigorous 5- to 7-node cuttings with swollen root buds at several nodes have rooted and successfully established normal plants under field conditions; under favorable soil-moisture conditions in the field, successful propagation in as high as 90 per cent. of the cuttings was not unusual. All leaves on each cutting were left intact, the youngest leaf being usually approximately one third full grown. On planting, the entire cutting was covered with soil except the youngest leaf and the vegetative growing point subtended by it. No shading was required nor was the application of growth-promoting substances or other special growth aids necessary. It was observed that plants thus propagated grew more rapidly and fruited earlier than plants produced from seed.

This vegetative propagation permits the rapid and easy establishment of clonal lines of squash and facilitates physiological studies for which plants with a high degree of uniformity are essential. By making possible the immediate propagation of superior commercial types of greater uniformity and higher quality this method of propagation has an economic application in the tropics and subtropics, where heterogenous populations of squash exist.

WALLACE K. BAILEY
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BOOKS AND LITERATURE

Sulfanilamide Therapy of Bacterial Infections. By R. R. MELLON, PAUL GROSS and FRANK B. COOPER. Charles C Thomas Company, Springfield, Ill., 1938.

THE background of the discovery of prontosil in 1935 by G. Domagk remains clouded in obscurity. Of the many prior compounds that must have been studied by Domagk, in collaboration with the chemists Mietzsch and Klarer at the I. G. Dye Works in Germany, we have no record.

The entire development has been characterized by hasty application of laboratory findings to clinical practice, a fault partially justified by the life-saving nature of the therapy in many cases. Soon after Domagk's announcement of prontosil, Tréfouel, Nitti and Bovet at the Pasteur Institute demonstrated that sulfanilamide was an active fraction of the prontosil molecule, and subsequent work has shown it to be more active and less toxic than prontosil.

Originally believed by Domagk to be specific for streptococcic infections, work from various laboratories showed that the following experimental infections could to varying extents also be influenced by this type of therapy: Meningococcus, pneumococcus, staphylococcus, typhoid bacillus, Welch bacillus. Clinical trial, followed by laboratory studies, brought the gonococcus and *B. abortis* within the pale of curative action. Slight action has been found upon animals infected with choriomeningitis virus, canine distemper virus, influenza virus and the virus of lymphogranuloma inguinale. Much optimism for the future of chemotherapy can be drawn from this imposing start and from the fact that some sulfonamide compounds exhibit special activity against certain of these infections. The infections against which the most marked action can be shown in the laboratory—streptococcus and meningococcus—have been the ones yielding the most favorable results in the clinic.

It was inevitable that a wide-spread search would be begun for new compounds, and a baffling number have already been reported in the scientific and patent literature. Drs. Mellon, Gross and Cooper list several pages of them, including the more active diphenyl sulfones.

Considerable space is devoted by the authors to the various phases of mechanism of curative action. Bacteriostatic effects of sulfanilamide have been demonstrated both in culture media and in body fluids. This effect, although definite, is weak. The rôle of neutralization of bacterial toxins and of interference with capsule formation remains to be established. There is general agreement that the drug acts on the organism in some way whereby the natural defense forces of the body are rendered better able to cope with the infection. Potentiation by the drug of the action of antiserum has been demonstrated both in culture and in the infected animal. More satisfying evidence is needed to clarify the mechanism of action, although it must be remembered that the problem of mechanism in the case of most other chemotherapeutic drugs has resisted attempts at solution. Interesting is the demonstration *in vivo* of the "antitoxin" action of some of these sulfur compounds.

Pharmacological and pathological studies of these new compounds have regrettably lagged behind therapeutic investigations, and such important issues as chronic toxicity effects and metabolic studies remain to be more fully explored. It has been established that excretion of sulfanilamide is chiefly through the urine, partially in the free state, and in some species (including man) partially acetylated. Excretion is rapid, and the major part of the drug can be recovered from the urine within 12 hours after an oral dose.

Experimental evidence of curative action for streptococcal infections has been obtained largely from mice. As the authors point out, comparison of results is difficult because of the many variable factors in such experiments which have not been standardized. However, this demonstration of curative action from many laboratories under many different conditions affords a solid experimental foundation for the future progress in this field. As evidence that the drug does not kill the organisms in the body, viable streptococci can be recovered from animals apparently cured; delayed death is also frequent after cessation of therapy. Unexplained is the evidence that drug therapy is more effective against organisms of high virulence than against those of low virulence. It is also to be noted that relatively large doses of sulfanilamide (approximately one fifth of the tolerated dose) are required to bring about high percentages of cures in infected mice.

The authors review the various reports dealing with hemolytic streptococcal infections in man treated with sulfanilamide and related compounds. Included are their own experiences in this field. While the early enthusiasm will undoubtedly suffer some later discount, the striking results obtained in erysipelas, streptococcal septicemia and puerperal sepsis testify to a therapeutic effect, and the recovery of the majority of cases of streptococcal meningitis, hitherto highly fatal, must carry conviction even to the doubters.

The results in cases of alpha streptococcus (viridans) infections have unfortunately shown no curative action.

Experimental work upon meningococcal infections in mice showed sulfanilamide to have marked curative action. This action was independent of immunological type, but varied with different strains. The best laboratory results have come from the combined use of drug and specific antiserum. Clinical experience, while favorable, is as yet insufficient for an evaluation of this therapy.

The action of sulfanilamide in pneumococcal infections in mice is much weaker than upon streptococci. Curative effects are pronounced in rats, however, either when infected intraperitoneally or when a pulmonary lesion is produced by intratracheal injection of the organisms. Experiments indicate a synergism between drug and serum therapy in this infection also. No comment can be made on the few cases of pneumococcus infections in humans on which information is available concerning this therapy. Significant, however, are the recent results reported with drug plus serum in pneumococcal meningitis. Also promising are the results with a pyridine compound of sulfanilamide in pneumococcus infections, recently reported.

Staphylococcal infections in animals respond slightly to sulfanilamide therapy. Some of the newer compounds were found more active, but those derivatives studied (sulfanilyl sulfanilamide) possess neurotropic side actions in man that discourage their clinical trial. Results with sulfanilamide in staphylococcal infections in man have not been promising.

Clinical evidence indicates that sulfanilamide therapy offers hope in the treatment of undulant fever, another disease for which no effective therapy previously existed.

Perhaps the widest use of sulfanilamide has occurred in the treatment of gonorrhea. Many reports are available, unfortunately poorly controlled or uncontrolled. The many favorable reports speak for a beneficial effect, the limitations of which must be established by further experience. Similar remarks can be made in reference to its use as a urinary antiseptic.

The wide-spread use of sulfanilamide soon brought to attention that the drug was not harmless. It was also found that the symptoms of toxicity in man differed considerably from those in mice and rats. In these animals 1.0 gm per kilo is tolerated for weeks without ill effects. In man the usual daily doses of 0.02 to 0.1 gm may cause (1) cyanosis, the exact nature of which remains to be determined, (2) fever, often delayed several days from onset of therapy, (3) acidosis, the mechanism of which is unexplained, (4) dermatitis of various types, one of which follows exposure to sunlight, (5) blood changes, particularly hemolytic anemia and neutropenia; a few instances of agranulocytosis have been attributed to this drug, (6) dizziness and digestive symptoms, common but not serious.

With the development of methods for the determination of sulfanilamide, attempts have been made to correlate the concentration reached in the body fluids, with therapeutic results or with toxic manifestations. As it has not yet been established whether these effects are the result of sulfanilamide itself, or other products formed from it in the body, the limitations of such investigation must be borne in mind. Important, however, is the rapidity with which the drug penetrates to all parts of the body, even when administered orally.

The authors describe experiments from their laboratory whereby accessory factors of body fitness are of importance in the fight against infection. A beginning has been made in this direction.

There is justifiable optimism from the experimental results with new compounds. Compounds with many times the activity of sulfanilamide are being obtained. Derivatives with specialized action against certain infections have been found. The field is still in its infancy, but the outlook for better and safer compounds and for new conquests in the field of infectious diseases is indeed bright.

From the context of this review it is evident that most phases of this subject can be treated with little finality at the present time. In a field as rapidly moving as bacterial chemotherapy a book is necessarily at a disadvantage in that important developments are prone to follow closely upon its heels. The authors have attempted in some way to offset this disadvantage by adding an addendum to the book. However, for those interested it is desirable to have the pertinent facts in this important field collected together at frequent intervals. The authors are well suited to this task because of their experience both in the laboratory and in the clinic.

Sanford M. Rosenthal

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SPECIAL ARTICLES

HYDROSOLS AND ELECTROLYTIC IONS

While electrodialyzing some solutions of clay in water and in dilute acids and alkalies, a curious relation has appeared which throws light on the association of the electrolytic ions with certain of the hydrosols which may be present.

If a montmorillonite clay be brought to equilibrium with a dilute acid solution (say 1 per cent. hydrochloric) and then filtered and the solution electrodialyzed, it will be found that the silica is carried *equally* in both directions. Other ions present are usually found unequally in anode and cathode liquors, but the silica is strictly amphoteric, it either consists of equal numbers of anions and cations or is a carrier of equal numbers of such ions. After the effect was first noted, other experiments (25 in all) were made at different acid and alkali concentrations and on various clays including soil, all confirming the original findings or indicating necessary conditions.

The dialyzer used was an ordinary Mattson with the electrodes supplied replaced by others of sheet platinum. Cellophane membranes enclose the cell 1×10×15 cm. Electrode compartments are 3×10×15 cm. The current used was from a 116-volt line and held to below one ampere by a 100-watt lamp in series. Anode and cathode liquors were replaced by fresh distilled water four times at hourly intervals and each analyzed separately.

The clay solutions were prepared by digesting about 30 grams of 150 mesh (0.1mm) clay in two liters of acid solution for fifty hours at about 90° C. with frequent stirring. A few acid clays and acid-treated adsorbent bentonites require twice as long to bring to equilibrium. About 400 cc of the filtrate was evaporated to 150 cc for the dialysis. The total recoverable solids is from 1.5 to 5 grams per liter of solution according to acid concentration. At equilibrium, there is always free and adsorbed acid present as well as salts in solution.

Electrodialysis of a solution that has not come to equilibrium with a clay or soil shows an unequal partition of silica; an acid clay shows an excess of silica transported as cations, while a slightly alkaline soil gives a slight excess of silica as anions.

The first ions removed are H^+ and Cl^-. After the first hour the cations are largely the R_2O_3 bases. If an electrodialysis of an equilibrium solution is stopped at an early stage and the three solutions analyzed, the silica will be found in equal amounts in anode and cathode liquors as though run to completion. When a pure silica gel solution is electrodialyzed, the silica is equally divided. An alkaline solution of a neutral clay (Florida fuller's earth) gave four times as much anion silica as cation silica. The same solution neutralized with HCl just before dialysis showed an equal division (49 vs 51 per cent.) of silica. A water solution of an alkaline bentonite (Wyoming swelling, 1.2 grams per liter) dialyzed 64.6 + vs 33.5 – without and 48.1 vs 43.7 – with HCl added before dialysis. But the same solution with NaCl added before dialysis gave for + silica 95.5 vs – 4.5. When insufficient ions are present electrodialysis gives a precipitate of silica in the cell.

It seems hardly possible that silica in solution can consist of equal numbers of anions and cations. The alternative seems to be that other charged ions are adsorbed in equal numbers on the silica and supply the motive power in a potential gradient. Anions and cations are present in necessarily equal numbers, hence in equilibrium clay or soil solutions they must also adsorb in equal numbers on the silica hydrosol micellae with which the cations were previously associated. Certain added ions prevent equal adsorption, others do not.

These results will be given in more detail in a later paper. It would be of interest to know whether similar relations obtain in other fields, say in the relation of the silver halides to the gelatine in photographic emulsions, of ions to hydrosols in sugar solutions, in plant saps and the like.

P. G. Nutting

U. S. Geological Survey

THE ASEXUAL LIFE CYCLE OF THE AVIAN MALARIA PARASITE, PLASMODIUM CIRCUMFLEXUM[1]

Evidence has been accumulating for some time that the life-cycle of the malaria parasite in the vertebrate is less simple than has been thought and that the plasmodia are able to parasitize not only the erythrocytes but also other types of vascular or phagocytic cells. This was first shown to be true of *Plasmodium elongatum* by Raffaele[2] and shortly afterward by Huff and Bloom.[3] This species of avian plasmodium may be found in any type of blood or blood-forming cell, although it much prefers the erythrocytes. Since the work on this species, Raffaele,[4] Kikuth and Mudrow[5] and James and Tate[6] have been able to demonstrate that there are also exoerythrocytic stages in *Plasmodium praecox, (relictum), cathemerium* and *gallinaceum,* respectively; Kikuth[7] in a recent paper with Mudrow has given a good summary of our knowledge of such stages to date. He remarks, however, that although he has looked for stages of this sort in *Plasmodium circumflexum* infections he has not as yet been able to find them. It may be noted here that the three species last named differ from *Elongatum* in that the parasites occur in the cells of the reticulo-endothelial system and, of course, in the red cells also, rather than in all the blood and blood-forming cells.

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[1] From the Department of Zoology, Syracuse University, Syracuse, N. Y.

The authors of the present paper have for some time been engaged in a study of the immunological characteristics of various strains of *Plasmodium circumflexum,* and as a somewhat incidental part of the study a number of infected birds (female canaries) have been examined for possible exoerythrocytic stages. As a result it is possible to say that such stages occur in at least four strains, and they have so far been found in the lungs, spleen, liver, heart muscle, bone marrow and brain, but not in all the birds examined. Of the thirty-six birds in which they have been looked for, they were seen in fifteen of twenty-one active cases, and not in any of the fifteen chronic cases. Of the four strains, one originated in Germany, one in Cape Cod and the other two in Syracuse. Our results suggest that stages in other than the red cells are most likely to be found soon after parasites first appear in the peripheral blood, and prolonged search may be necessary to find them. Once found, however, they are frequently found to occur in localized areas in great numbers.

The question has recently been raised by Hegner and Wolfson[8] as to whether, in certain cases at least, the parasites found in cells of the reticulo-endothelial system and interpreted as part of the asexual cycle of malaria, are not actually *Toxoplasma.* This is quite possible under some circumstances, for *Toxoplasma* may spread rapidly in the laboratory once it is present at all, and some stages strongly resemble what has been regarded and figured as exoerythrocytic schizogony in the avian malaria species mentioned above. It should be pointed out however that *Toxoplasma,* usually, if not always reproduces by binary fission. In our experience, *Toxoplasma* has occurred only once in laboratory canaries, and in this case it was apparently acquired from English sparrows. The infection spread very rapidly among the sparrows and killed a number of them, but it had no connection with malaria at all, since most of the sparrows had been previously shown to be free from malaria infection of any kind. We have seen no evidence of *Toxoplasma* in canaries since, although numerous birds have been studied and autopsied over a period of several years. For this reason and because the stages which we have found in the *circumflexum*-infected birds mentioned above are much like those seen by the other investigators already cited in connection with the work on *praecox, cathemerium* and *gallinaceum,* we believe that in *circumflexum* also it may be regarded as demonstrated that exoerythrocytic stages occur. From the evidence already existing it seems likely that similar stages will be found in the other species of avian malaria, and quite possibly in monkey and human malaria also. It also makes it probable that the biological relationship between the malaria parasites and *Hemoproteus* and *Leucotozoan* is closer than has been thought.

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[2] Raffaele, *Riv. di Mal.,* 13: 332–337 and 402, 1934.

[3] Huff and Bloom, *Jour. Inf. Dis.,* 57: 315–336, 1935.

[4] Raffaele, *Riv. di Mal.,* 15 (5), Sez. 1, 3–9, 1936.

[5] Kikuth and Mudrow, *Klin. Wschr.,* 16 (48): 1690–1691, 1937.

[6] James and Tate, *Nature,* 139: 545, 1937.

[7] Kikuth and Mudrow, *Zentralbl. Bakt.,* I Orig., 142: 113–132, 1938.

[8] Hegner and Wolfson, *Amer. Jour. Hyg.,* 27: 212–220.

THE PREVENTION OF TOXIC MANIFESTATIONS OF AN EXCESS OF VITAMIN B_1 BY SUPPLEMENTS OF MANGANESE TO THE DIET[1]

IN an earlier publication we reported that the addition of supplements, to our standard adequate diet, of vitamin B_1 in amounts of 50 international units per rat per day resulted after one generation in interference with lactation, loss of the maternal instinct, cannibalism and progressive loss of fertility.[2] Our standard diet contains rolled oats, meat scrap and bone meal, dried skimmed milk, fresh greens, fresh milk, salt, cod liver oil and brewer's yeast (in amounts equivalent to 2 or 3 international units per rat per day). With reduction in the excess amount of vitamin B_1 to 20 units or the elimination of the excess supplements of vitamin B_1 for short periods, normal lactation and normal interest in the young was restored. When the vitamin B_1 content was again increased the same toxic effects were observed. Further study completely confirmed our earlier findings. With supplements daily of 30 units of vitamin B_1, progressive decrease in fertility also occurred with a moderate incidence of loss of litters due to cannibalism. After five generations breeding markedly decreased.

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[1] From the Laboratory Division, Montefiore Hospital, New York City.

[2] D. Perla, *Proc. Soc. Exp. Biol. and Med.,* 37: 169, 1937.

In view of the fact that Williams[3] stated that as much as from 160 to 1,000 γ of vitamin B_1 daily could be given without any toxic effects when rats were fed a Sherman breeding diet (one third whole milk and two thirds whole wheat), it seemed probable to us that interference with some other essential factor in the diet may have induced the manifestations observed in our experiments.

It is known that deficiency of manganese in the diet presents similar toxic effects on the maternal instinct and reproduction.[4] It was reasoned that perhaps manganese is essential as an oxidative catalyst in the utilization of vitamin B_1 in the tissues. If this is so the available manganese in the tissues may be exhausted by an excess of vitamin B_1, and analogous manifestations would occur as is observed with a deficiency of manganese.

To test our hypothesis we added small amounts of manganese to the diet. Rats which had shown loss of maternal instinct and cannibalism now bred and raised normal litters. The studies were then extended. Rats were raised on the normal diet and given parenterally 200 units of vitamin B_1 daily. Others were given the same diet and vitamin B_1, but the diet was supplemented with 2 mg of manganese as $MnCl_2$ per day per rat. In those receiving the vitamin B_1 alone, cannibalism and interference with lactation occurred in a high percentage in the P and F_1 generation in successive litters (13 of 22 litters). In those receiving in addition supplements of manganese in the diet, none of these toxic symptoms were apparent and the normal maternal instinct and normal lactation were preserved (in a total of 25 litters). In our normal stock observed during the same period no loss of litters occurred.

These results demonstrate that manganese is essential in the utilization of vitamin B_1 in the tissues and is intimately bound up with the role of vitamin B_1 in the physiology of the organisms. It also suggests that variations in certain constituents of the diet, such as manganese, may greatly affect the vitamin B_1 requirement. With the use of large amounts of vitamin B_1 in therapy, an adequate supply of manganese must be made available. As yet it is not known whether the protective effects observed with manganese are specific for manganese as such or would be obtained with other oxidative catalytic metals such as cobalt or copper.[5]

DAVID PERLA

SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE USE OF THE NEON GLOW LAMP IN THE PHYSIOLOGICAL LABORATORY FOR THE ELIMINATION OF MAKE INDUCTION SHOCKS

IN the use of an induction coil as a source of electrical stimuli for living tissue, in the physiological laboratory, it is often desirable to prevent the "make shocks" (the E.M.F. induced in the secondary coil when the primary circuit is closed) from passing through the tissue, and various devices are in use for short-circuiting the secondary coil while the primary circuit is being closed. While entirely satisfactory in performance, such devices, if arranged to operate automatically, are generally complicated and expensive.

While seeking a simple means of automatically eliminating make shocks, that would be suitable for use in the students' laboratory, we hit upon the idea of connecting a neon glow lamp in series in the secondary circuit. It happens that the Harvard coil and some of the other coils manufactured for physiological use in this country when used with one or two dry cells give make shocks that are too weak to ionize the gas in the lamp and are, therefore, not conducted through it; the break shocks, however, are readily conducted.

Since there is some loss of energy in the lamp, due to resistance, a high capacity lamp without auxiliary resistance gives best results. We have provided our students with two-watt glow lamps without resistance in the base. For convenience and sturdiness of mounting, lamps with radiatron base were obtained on special order from the General Electric Vapor Lamp Company of Hoboken, N. J. The sockets are recessed in small cast-iron blocks; suitable binding posts are provided for making connections.

The method has but one serious disadvantage. Since the secondary is not short-circuited and is open-circuited only for low voltage impulses, chatter or vibration of the key used to control the primary circuit must be avoided at the make; otherwise a succession of rapid makes and breaks occurs which induces a high enough potential in the secondary to pass through the lamp. Chatter is easily avoided with hand-operated keys, and electrically operated keys or relays should, in any case, be so designed as to close without chatter. Incidentally, since the lamp glows each time an impulse is conducted, chatter of the key and other defects in the electrical system are easily detected. It may be, also, that making the electrical impulse "visible" will prove to have advantages for teaching purposes.

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[3] R. R. Williams and T. D. Spies, "Vitamin B_1 and its Use in Medicine," p 286. Macmillan Company, New York, 1938.

[4] E. R. Orent and E. V. McCollum, *Jour. Biol. Chem.*, 92: 651, 1931.

[5] The vitamin B_1 for these experiments was kindly furnished by the Department of Medical Research of the Winthrop Chemical Company.

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USE OF THE LUNDEGARDH SPECTROGRAPHIC METHOD

A survey of the spectrographic methods used in this country for the quantitative determination of small quantities of mineral substances reveals the fact that the Lundegårdh[1] method is not employed here. In this method the emission spectrum is excited by means of the flame of a special air-acetylene burner, for which the acetylene and the air are supplied at constant pressure. The air is forced through a few milliliters of the solution of the substance under analysis, thus spraying the solution into the flame uniformly. In this way the spectra of 32 elements at different concentrations have been photographed and, from the intensity of a certain line in each, it has been found possible to make fairly rapid, quantitative determinations of great accuracy and dependability. This is especially true when the Lundegårdh system of constructing both a plate correction curve and a concentration curve for each plate is followed.

The problem of the determination of the mineral constituents of citrus fruits and of some vegetables has been in progress in this laboratory for some time. The material has been dried and ashed quantitatively and then the per cent. of calcium, copper, iron, magnesium, manganese and phosphate in the ash has been determined by micro-photometric or micro-volumetric methods. It has been necessary to use large quantities of the materials in order to obtain sufficient ash to carry through the above analyses. For instance, in the case of orange juice, a liter would be required. This process is long, subject to many sources of error, and dependent upon complicated technique, all of which are in great contrast to the Lundegårdh spectrographic method.

Professor Lundegårdh very kindly gave me the opportunity of working in his laboratory at the Agricultural College of Sweden this summer, and I was able to do some preliminary work on the determination of the mineral constituents of orange juice. By concentrating 100 ml of the juice nearly ten times and oxidizing the organic matter by one of several methods, for instance, by nitric acid and perhydrol, it was possible to obtain results for copper, iron and manganese which were of the same order as our photometric methods. (See Table I.)

TABLE I
Millemols Per Liter Juice

Oranges	Copper	Iron	Manganese	Method
Blue Goose	0.0061	0.042	0.0039	Lundegårdh
Sunkist	0.0072	0.030	0.0039	"
Valencia	0.0065	0.030	0.0043	"
South Africa	0.0068	0.043	0.0033	"
Average[2] for California and Florida oranges	0.0069	0.025	0.0044	Micro-photometric

[2] Honors paper of Annette Florence, Wellesley College, 1936.

It was also possible to determine such metals as potassium and calcium which are present in much larger quantities without concentrating the juice, but by refluxing with hydrochloric acid, filtering out the solid material—really a form of wet ashing—and then spraying into the flame.

In this laboratory at the present time we are continuing the study of the various ways of preparing these solutions, as well as the spectrographic and photometric procedures. It is especially important to carry out careful blank determinations because of the possible contamination from chemicals and apparatus when such small quantities of some elements are to be determined. We also expect to use this method for the determination of mineral constituents in various biological materials, for which it is particularly well adapted.

Mary A. Griggs

Wellesley College

BOOKS RECEIVED

Babcock, E. B. and G. L. Stebbins, Jr. *The American Species of Crepis.* Pp. 108. 34 figures. Carnegie Institution of Washington.

Crabtree, J. I. and G. E. Matthews. *Photographic Chemicals and Solutions.* Pp. 360. 95 figures. American Photographic Publishing Co. $4.00.

Darling, F. Fraser. *Wild Country; Creatures of Mountain, Island, Sea and Moor.* Pp. vii + 104. Illustrated. Cambridge University Press, Macmillan. $2.75.

King, John W. *Give Your Hair a Chance.* Pp. 157. Illustrated. Bradner Publishing Co., Cambridge, Mass.

Murray, Henry A. *Explorations in Personality.* Pp. xiv + 761. Illustrated. Oxford University Press. $8.50.

Rawdon-Smith, A. F. *Theories of Sensation.* Pp. xiii + 137. 18 figures. Cambridge University Press, Macmillan. $2.75.

Room, T. G. *The Geometry of Determinantal Loci.* Pp. xxviii + 483. Cambridge University Press, Macmillan. $10.00.

Shoenberg, D. *Superconductivity.* Pp. ix + 112. 22 figures. Cambridge University Press, Macmillan. $1.75.

Smith, Alexander H. *Common Edible and Poisonous Mushrooms of Southeastern Michigan.* Pp. 71. 15 plates. Cranbrook Institute of Science. $0.50.

Sollmann, Torald H. and Paul J. Hanzlik. *Fundamentals of Experimental Pharmacology.* Pp. vi + 307. 37 figures. J. W. Stacey, San Francisco. $4.25.

Stefansson, Vilhjalmur. *Unsolved Mysteries in the Arctic.* Pp. xi + 381. Macmillan. $3.50.

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[1] H. Lundegårdh, "Die quantitative Spektralanalyse der Elemente II." Jena, 1934; *Lantbrukshögsk:s Annaler,* Vol. 3, s. 49.

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GEOLOGY AND CHEMISTRY[1]

By Professor **NORMAN L. BOWEN**
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WE are here to-day with the pleasant duty of dedicating a splendid new building to the service of chemistry and geology. Some of you may have been led to wonder at the housing together under one roof of two sciences that are often placed in opposed categories, the one an experimental science, the other a natural science. But is it, after all, so strange a union?

Chemistry had a utilitarian beginning. It grew out of the attempts of man to convert natural materials to his uses. The first chemical process consciously employed was probably the process of combustion. Fire was to early man, as it is to us to-day, of outstanding importance, and one of its earliest services was that of reducing metals from their ores. A primitive hunter kindled a fire in the lee of a rusty boulder and was astounded to find in the ashes glistening pellets that he could shape at will by pounding them with a stone. From this beginning he and his fellows learned to associate the production of this lustrous, malleable material with the bringing together of fire and a certain kind of rock substance. When they wished more of that material, for which they found many uses, they learned to seek other occurrences of similar rock to be fired in a similar manner. The production of metals from natural rock substances was at first no more than a craft. But man does not long remain content with wholly utilitarian pursuits, else we should not find among primitive peoples the remarkable knowledge of such matters as the motions of heavenly bodies. Our nimrod metallurgist soon began to ponder upon the fundamental nature of his craft. In this act the science of chemistry was born, but no less also was the science of geology born, if indeed any purpose is served by attempting to classify the trains of thought instituted in those unpracticed minds. The desire to understand the real nature of the raw material, to grasp why it occurred in some places and not in others, knowledge which we should now call geological, must have been just as great as the desire to understand the process to which he subjected it and the product which he gained, nowadays chemical knowledge. It was all one problem. Increased knowledge of one aspect could not fail to shed light on other aspects. This condition persisted as knowledge advanced along these lines. One investigator engaged in all the necessary pursuits. Classification of activities was not emphasized and the broad general view prevailed well into the comparatively recent period during which the principal advances in chemical knowledge consisted in the progressive discovery of the elements. This was but natural, since they were found for the most part through the treatment of new raw materials, and each discovery threw new light on a naturally occurring substance. The system of knowledge that developed was regarded as a unit, and given the name "natural philosophy."

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[1] Address given at the dedication of the new Science Building of Bryn Mawr College, October, 22, 1938.

As the system grew, it was inevitable that some philosophers should pay greater attention to certain aspects of it. In the laboratory the investigator produced new compounds from old compounds and still newer compounds from these again, until finally he had substances so many steps removed from the natural raw materials that he might easily forget his ultimate dependence upon such materials. Thus there tended to grow up laboratory science as distinct from natural science and the connection between them was often temporarily lost to view. With what force must Marie Curie have been reminded of this connection when, with an electroscope of Pierre's construction, she examined a long series of geological specimens to determine what minerals emitted the mysterious Becquerel rays, and then, confining her efforts to the most promising material, she set to work in an old, draughty shed to treat ton after ton of a waste product of Bohemian uranium ores and isolated the astounding new element, radium. Her discovery revolutionized chemistry; it revolutionized geology, giving, for example, a wholly new vista of geologic time; it revolutionized all science. Just so thin, so unreal are the barriers between the sciences.

In their common interest in their common materials geology and the laboratory sciences tend to grow hand in hand. Chemists and physicists continue to discover new elements and new isotopes of the elements. The materials they treat come from the earth, and in their original home have long been studied by the geologist. Investigation of the chemical characters of minerals, rocks and ores, whether undertaken for utilitarian ends or with these fundamental problems of the constitution of matter in mind, will ever be an indissoluble bond between chemistry and geology—but it is not enough.

Geological science is not concerned solely with the nature of the materials of the earth. Geology is even more concerned with processes, with the changes to which earth materials have been subjected. It seeks to know not only what earth substances are, but how they have come to be what they are, what factors have led to the observed arrangements and associations. Such knowledge is the special domain of geology. Overlap into the fields of other branches of science is here not so obvious. The chemist may readily find it essential to the advance of his science to institute a study of the mineral pitchblende, but he is very unlikely, of his own accord, to investigate the chemical action of atmospheric ingredients upon the various constituents of rocks. He will ordinarily realize the importance of such studies only when the geologist points out to him the cumulative magnitude of such action in nature and then urges upon him the significance to both chemistry and geology of an exact knowledge of the processes involved. Absorbed in his own science the chemist might ordinarily never even realize the existence of such a phenomenon as rock weathering; yet, induced to study it, he might make discoveries of general significance to such problems as rates of reaction, adsorption by surfaces, formation of colloids and others destined to enrich scientific knowledge as a whole.

The weathering of rocks is only one of a great host of geologic processes, all of them chemical and physical processes occurring in or upon the earth, the true nature of which the geologist must seek to unravel. As a check upon his deductions regarding their nature it is in all cases most desirable that experimental studies be carried out under controlled and measured conditions and the actual importance of the various factors involved be thus ascertained.

At the risk of being technical and tedious it may be appropriate to point out very briefly a few of the many directions in which chemical studies have thrown or may be expected to throw new light on geological processes, with consequent enlargement of the domain of chemical science itself. Geologic processes may be regarded as beginning with the high-temperature phenomena. Some aspects of these are revealed in the outpourings of lava from volcanoes that have occurred throughout geologic time and have been observed by man with wonder and awe ever since he made his first appearance on the planet. Molten lavas solidify on cooling and ordinarily give rise to a crystalline aggregate of a number of different minerals, an igneous rock. The study of the manner in which minerals form from molten mixtures has now been carried on for some time. It constitutes a special branch of high-temperature chemistry or physical chemistry and has served to throw much light upon the temperatures prevailing and the processes at work during the consolidation of masses of molten rock. At the same time chemistry extended its domain and many facts came to light that are of fundamental significance to certain branches of the chemical industry, such as the manufacture of glass, cement and refractories.

In spite of notable progress in these laboratory investigations of igneous-rock formation much remains to be accomplished. The most superficial observer of volcanic eruptions realizes that the lavas poured out are not simple melts but that they contain dissolved in them many substances which are gaseous at the high temperatures prevailing. Investigation proves that the principal of these is water, but many others are present, among which may be mentioned chlorine, fluorine, sulfur. To the presence of these substances volcanic activity owes its frequent explosive character, and their reactions with each other and with the less fugitive constituents of the lavas are of great importance to an understanding of volcanic phenomena. The investigation of these reactions in the laboratory is a special field of high-temperature and high-pressure chemistry that is warranted to tax the ingenuity of the most accomplished experimenter, and the theoretical treatment of the results will require a most facile mind. If the reward is measured by obstacles overcome, a generous reward awaits the successful experimenter in this field. Significant results have already been obtained, but they serve principally to whet the appetite for more.

In discussing high-temperature geologic processes it is but natural to begin with those that are manifested directly upon the surface of the earth. At the same time it should be realized that the lava poured out during a volcanic eruption is ordinarily but an insignificant spurt from a large reservoir of molten rock existing at considerable depth within the earth and that this large mass itself cools and crystallizes with the passage of time. Thus have arisen many deep-seated masses of igneous rock. Frequently these have been laid bare as a result of the wearing away of mountains by streams, with consequent exposure of the "roots" of the mountains at the surface of the earth. The geologist is thus enabled to study the products of the aeon-long cooling of molten masses of rock, and these, not lavas, are the most important and the most abundant of the primary or igneous rocks. He finds here many interesting contrasts with the same materials when cooled quickly as surface lavas. Instead of making violent escape from the magma it is apparent that the volatile constituents, for the most part, remained in solution in the melt when it thus cooled under a considerable cover of overlying rocks. The volatile constituents were therefore enabled to exert important influence upon the crystallization of the magma. In large measure they remained in solution until late stages of crystallization and thus attained high concentrations in the residual liquids. In part they entered into the composition of the later-formed minerals. In part they escaped into surrounding rocks as liquid or gas and carried with them in solution many substances that were concentrated with them. These they often deposited at favorable localities in the surrounding rocks, and thus arose many of our most valuable ore deposits.

This is the general story of the formation of such deposits, as deciphered by the geologist from their field relations. The full details of the process and decision upon many moot points can be had only as a result of properly designed laboratory experiments. Such work constitutes a field of moderate-temperature, moderate-pressure chemistry of solutions of most complex character. Something has been accomplished in the field, but progress in it lies in the development of new techniques. Critical phenomena will be encountered and most complex relations between the various states of matter. The requirements are most exacting, the promise of results of general significance is great. The field should prove attractive to the chemical investigator.

At an earlier point I have mentioned the problem of rock weathering and its challenge to the chemist. From the moment a rock is exposed at the surface it suffers attack both mechanical and chemical, actions which, as we have seen, are susceptible of laboratory investigation. Running water transports the products of decomposition, partly in suspension, partly in solution. Broadly speaking, their ultimate destination is in the sea, where some remain in solution and are there building up to higher and higher concentrations with the passage of the ages, and others are deposited upon the sea floor as mechanical or chemical sediments. The mechanical sediments are sands and muds, and on first thought it might seem that their deposition presents no chemical problems. Yet closer examination reveals that this is far from the truth. Precipitation is in some measure related to the degree of concentration of electrolytes in solution, fine particles adsorb salts and do so selectively, so that even the detrital sediments raise many chemical questions.

Such questions are, of course, paramount for chemical sediments, the most important of which is perhaps limestone, though by no means all limestones are simple chemical precipitates. The chemistry of the formation of this common rock still presents many unsolved problems. There are other, less common chemical deposits of great interest. In some circumstances many substances of relatively low solubility in sea water have been deposited from it as extensive beds. Silica as beds of chert and silica interlaminated with iron oxides are prominent examples. To the reworking of the latter we owe the great bodies of iron ore in the Lake Superior region. Beds of calcium phosphate have also been formed, and they have great importance as a source of fertilizer. The special conditions under which these diverse materials are separated from sea water are at present not much more than a matter of conjecture and they will remain so until they have received adequate chemical investigation.

No purpose can be served by multiplying examples, but it would be an ill-balanced discussion of our present topic which failed to mention salt deposits. In the never-ending movements of the body of the earth, and consequent warping of its surface, it sometimes happens that arms of the sea are cut off and are subjected to slow evaporation. Under these conditions even the very soluble salts have been deposited and thus have arisen many salt and gypsum beds and, in extreme cases, beds containing potassium and magnesium salts. A laboratory investigation by Van't Hoff of the conditions of formation of these several deposits is a chemical classic.

All these processes of weathering, transportation and deposition of substances belong to a field of chemistry of ordinary temperatures and pressures. Laboratory investigation of them requires a minimum of apparatus and equipment and for the most part familiar techniques. A vast field is open.

Geology, we have seen, is concerned with the materials of the earth and with the processes that have wrought changes in these materials and we have striven to show how both these aspects of the science are connected with the science of chemistry. Geology has yet another aspect. It is concerned with the inhabitants of the earth, the various forms of life that have existed upon it and with the conditions under which they lived. The connection between geology and biology is here the more obvious one, yet we can not think of the environment of life through the ages without regard for its chemical aspects. Changes in the character of sea water and of the atmosphere are of great importance, and much chemical and biochemical research with an eye to geologic interpretation remains to be accomplished here. Living organisms have, too, contributed great deposits to the geologic column, the most significant, perhaps, limestone and coal. The chemistry of the processes involved, say in the development of coal from plant remains or in the development of petroleum, still requires much research for its elucidation. Limestone and coal have been listed among the five or six fundamental raw materials of the chemical industry, and even one engaged in the most abstruse research in pure chemistry should not be utterly oblivious to chemical industry's raw materials and the problems which they pose. Here again there is opportunity for collaboration between geology and chemistry.

Enough has been said to make it clear that each of the three major aspects of geology presents problems where chemistry and geology come together upon common ground. How appropriate it is then to bring these sciences together under one roof! As much could be said for housing physics and geology together, but it is, for the most part, unnecessary to say it. Cooperative efforts of physics and geology have in the recent past proven so fruitful in a commercial way that it is relatively easy to arouse interest in and obtain support for such investigations, even when extended to what might be termed problems of pure geology. Indeed, plans for extensive geophysical research in pure geology are now being pushed with great vigor. Such research has the great advantage, or should I say the seeming advantage, of great general appeal. What could be more stirring than artificial earthquakes, than weighing the earth or than boring holes in the bottom of the sea? In such work explanation is sought of such large-scale phenomena as thrustings of the earth's crust, changes in the level of the sea and many others. It has great promise and every effort is justified, yet it is possible that these actions have their ultimate origin in changes of phase equilibria within the earth, dominantly a chemical phenomena, if indeed we should here draw any boundary line. And if the good ship *Geophysica* should outsail her sister ship *Geochemica* she will soon find that she is off her course, that she can not hope to make port but must put about and join her sister. Together they can continually correct the course and sail on with confidence.

So, though the grouping of physics and geology would be entirely appropriate, I believe the grouping of chemistry and geology has its advantages in these times. Physics is here housed with biology. They have, I need hardly say, much common ground, and their grouping may lead to cooperation between branches which would otherwise go their separate ways. And when we have said these things we can not fail to be brought to a realization of the artificial nature of *any* particular grouping, of the arbitrary character of the boundaries that have been set up in science and of the essential unity of all science, a unity more fully appreciated in earlier days than in these days of extreme specialization. His own realization of this fact and his conviction that great benefit would accrue to science if this realization were more general are, no doubt, the factors that led Professor Tennent to formulate his plan of balanced instruction in science, without extreme specialization at the undergraduate level, a plan which the administrators of this college have wisely adopted. Many colleges turn out geologists with no more than a smattering of chemistry, and many turn out chemists altogether devoid of geological knowledge. Often enough the deficiency may not be a

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ause I myself have been much interested in the field of plant breeding, I have been asked to speak to-day on the subject of "Racial Theories and the Genetic Basis for Democracy."

Claims to racial superiority are not new in the world. Even in such a democratic country as ours, there are some who would claim that the American people are superior to all others. But never before in the world's history has such a conscious and systematic effort been made to inculcate the youth of a nation with ideas of racial superiority as is being made in Germany to-day.

Just what are these ideas? Let me quote from a translation of the "Official Handbook for the Schooling of the Hitler Youth," the organization which includes some 70 per cent. of all the boys and girls in Germany of eligible age.

The handbook discusses the various races found in Germany and other parts of Europe. Concerning what it calls the Nordic race, it says: "Now what distinguishes the Nordic race from all others? It is uncommonly gifted mentally. It is outstanding for truth and energy. Nordic men for the most part possess, even in regard to themselves, a great power of judgment. They incline to be taciturn and cautious. They feel instantly that too loud talking is undignified. They are persistent and stick to a purpose when once they have set themselves to it. Their energy is displayed not only in warfare but also in technology and in scientific research. They are predisposed to leadership by nature."

But here is what the handbook says concerning what it calls the "Western Race," found principally in England and France: "Compared to the Nordic race there are great differences in soul-qualities. The men of the Western race are . . . loquacious. In comparison with the Nordic . . . men they have much less patience . . . They act more by feeling than by reason . . . They are excitable, even passionate. The Western race with all its mental excitability lacks creative power. This race has produced only a few outstanding men."

That is the end of the quotation.

Thus the dictatorial régime in Germany, masquerading its propaganda in pseudo-scientific terms, is teaching the German boys and girls to believe that their race and their nation are superior to all others, and by implication that that nation and that race have a right to dominate all others.

That is the claim. What ground does it have in scientific fact?

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material success. The broadening of interests that results from a well-rounded training may well lead to comparative indifference to material success and thus to a life in which there is time to observe our surroundings and to contemplate upon their meaning. The scientific outlook is not likely to be gained from too great and too early specialization in science with its feverish acquirement of techniques, but rather from a broad, general training in science; and the scientific outlook on life and living is sorely needed in these days of heated passions and rampant prejudices.

Yes, broad undergraduate training in science should be a valuable preparation for living. The exigencies of college curricula ordinarily make it necessary that the undergraduate training be also a preparation for specialization. Will such specialization be handicapped because the preparation was so broad that it could not be deep? Probably not. The specialist can benefit greatly from knowledge of other fields. More and more does one branch of science depend upon borrowing from other branches. As a result have grown up special branches that have been termed borderland sciences and have received names that emphasize that character. Among them there are biophysics and geophysics, biochemistry and geochemistry. The last is born of the union of geology and chemistry, the two subjects of which our building is to be the home. We have considered something of what has been accomplished and what we may look for in the field that is common to these two sciences, and in general it may be said that the major advances in the great natural sciences biology, geology, astronomy must come through the development of the borderlands where they march against chemistry, physics and mathematics. The past has been mainly a period of fact-finding, but science can be stifled by facts. It is only when processes are considered and properly understood that a horde of little facts becomes a single great fact and real scientific progress is made. The natural sciences have generalizations of surpassing grandeur that are truly their own; but it now seems that further generalizations will arise dominantly through development of their borderland fields.

The worker who prepares himself especially for investigation in the borderland between chemistry and geology may expect a singularly attractive existence. To-day he is in his laboratory making careful measurements and obtaining results the probable error of which he can state within certain definite limits, a condition that is most satisfying to the scientific type of mind. But confinement between four walls, close application and a sedentary existence eventually pall,

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of the most popular political devices has been to blame economic and other troubles on some minority group. But no one can claim with scientific certainty superiority for any race or nation so far as its inborn genetic characteristics are concerned.

Indeed no nation in Europe is a greater mixture of tribes and breeds than the Germans. This is of course nothing against them, but it makes absurd the claims of superior stock. The word Aryan as used by scientists and not by dictators means the people of the Caucasian race who speak one or another of the Indo-European languages. (Any one can look it up in his dictionary.) Jews are of course Aryans, so are Hindus, so are Germans and French and English and most Americans. The dictators' misuse of the word Aryan is pure scientific faking.

Two thousand years ago there was nothing about the ancestors of the modern English or Germans to indicate either scientific, artistic, inventive or philosophic ability. Neither their traditions nor their economic opportunities permitted development along these lines. No scientist can say to-day with any certainty that many of the so-called backward races and nations do not have inborn genetic capacity which might flower unusually in the sciences, the arts or philosophy, provided only economic conditions and social institutions permitted.

When I was a small boy, George Carver, a Negro who is now a chemist at Tuskegee Institute, was a good friend of my father's at the Iowa State College. Carver at that time was specializing in botany, and he would take me along on some of his botanizing trips. It was he who first introduced me to the mysteries of botany and plant fertilization. Later on I was to have an intimate acquaintance with plants myself, because I spent a good many years breeding corn. Perhaps that was partly because this scientist, who belonged to another race, had deepened my appreciation of plants in a way I could never forget.

Carver was born in slavery, and to this day he does not definitely know his own age. In his work as a chemist in the South, he correctly sensed the coming interest in the industrial use of the products of the farm—a field of research which our government is now pushing. I mention Carver simply because he is one example of a truth of which we who meet here to-day are deeply convinced: Superior ability is not the exclusive possession of any one race or any one class. It may arise anywhere, provided men are given the right opportunities.

It is the fashion in certain quarters to sneer at those so-called "poor whites," who suffer from poor education and bad diet and who live in tumble-down cabins without mattresses. And yet I wonder if any scientist would care to claim that 100,000 children taken at birth from these families would rank any lower in inborn ability than 100,000 children taken at birth from the wealthiest one per cent. of the parents of the United States. If both groups were given the same food, housing, education and cultural traditions, would they not turn out to have about equal mental and moral traits on the average? If 100,000 German babies were raised under the same conditions as 100,000 Hindu babies or 100,000 Jewish babies, would there be any particular difference? No such experiments have been made or are likely to be made and so no absolutely scientific answer can be given. But when I raise such a question, I mean to imply that every race, every nation and people from every economic group of society are a great genetic mixture. There is far greater variability between the heredity of individuals within the groups than between the groups. There may be a certain amount of stability of type with regard to skin and eyes and hair, but with regard to mental and emotional characteristics there is very little evidence of genetic uniformity for any race or nation. There may be a great deal of uniformity with respect to traditions but not with respect to complex hereditary characters.

In all this I do not mean to say that heredity does not work with human beings just as truly as it does with plants and animals. Nor do I mean to deny that a master breeder living for a thousand years might do extraordinary things in the way of fixing human types of unusual longevity, resistance to disease, musical ability or any one of a number of characteristics. A master breeder who had a dictator's control for several generations might be able to fix a standard blue-eyed, long-headed, fair-haired type of the most approved Nordic specifications. But from our studies in livestock breeding we know that the more complex characteristics are usually altogether separate from such superficial characteristics as skin, hair or eye color. The color of a cow's hair, for instance, has nothing to do with her ability to produce milk and there is no reason to think that the color of a man's hair has anything to do with his ability to produce ideas. And so it is quite possible that the master breeder, being concerned primarily with physical appearance, would find he had produced a group of blonde morons—useful to him mainly as a superior type of cannon fodder.

On the whole, it seems probable that nowhere in the world in the next couple of centuries will a genuinely scientific attempt, in the sense understood by the plant or animal breeder, be made to breed for superior types of human beings. The different races and nations will continue to be conglomerates with a vast variability of mental and emotional qualities and the other abilities which make for leadership and genius.

Here in the United States, our own population is a blend of many races. Men and women of many races have built our science, our literature and our art—our finance, our industry and our government. The noblest chapters in our history have been those filled with struggle against tyrannical denial of freedom.

I am convinced, as a result of my study of genetics, that there is nothing in science to interfere with what might be called a genetic basis for democracy. The seed bed of the great leaders of the future, as of those of the past, is in the rank and file of the people.

Environment, of course, will continue to be very important. Because of superior opportunities an undue proportion of our great leaders may perhaps come from the wealthier five per cent. If there is somewhat greater diffusion of opportunity and wealth—if the children of all classes get enough to eat and good schooling—if all children are given an opportunity to *realize to the full their inborn faculties to serve the* general welfare, we may expect genius to sprout more evenly from all economic classes of society. In a study of human genetics recently made by the National Resources Committee, it was found that among given racial groups, intelligence ratings varied with the environment. Intelligence quotient ratings generally *seem to be more a matter of education and upbringing* than of heredity.

Just as a favorable environment is needed to help the development of great leaders and great scientists, so a good environment is essential to preserve our liberty. The imperative need is for us to ask ourselves under what conditions our liberty can be lost. Under what conditions do men of the ruthless dictator type rise to power in a modern nation? Under what conditions do they persuade a whole people to accept a philosophy, and to follow a line of action, that violates many of the finest achievements of humanity and exalts many of the worst? Under what conditions are great numbers of men willing to surrender all hope of individual freedom and become ciphers of the state? Under what conditions will the scientist deny the truth and pervert his science to serve the slogans of tyranny? And again, how can those conditions be prevented from occurring in our country?

In seeking to answer these questions honestly, we shall inevitably come upon certain truths that are not flattering to us. We shall find in our own country some of the conditions that have made possible what we see abroad. The seeds of these conditions exist here. It is not enough simply to hope that these conditions will not reach such extremes here as they have in some other countries. We must see to it that they do not.

When a political system fails to give large numbers of men the freedom it has promised, then they are willing to hand over their destiny to another political system. When the existing machinery of peace fails to give them any hope of national prosperity or national dignity, they are ready to try the hazard of war. When education fails to teach them the true nature of things, they will believe fantastic tales of devils and magic. When their normal life fails to give them anything but monotony and drabness, they are easily led to express themselves in unhealthy or cruel ways, as by mob violence. And when science fails to furnish effective leadership, men will exalt demagogs, and science will have to bow down to them or keep silent.

The ironic fact is that the economic maladjustments of the present day which threaten our democracy and the freedom of science are in large part due to the changes wrought by science. In a democracy, every individual according to his station in life and according to his capacity should have opportunity for joyous service of *the general welfare*. Scientists, by their discoveries and inventions—which in countless ways have enriched our lives—have at the same time, without intending to do so, helped to break down this kind of democracy. Quite without intention, they have helped to replace it with an industrial system in which a small number of individuals make the decisions and the great *majority have no feeling that they are taking part* according to their capacity on equal terms in a common enterprise. Quite without intention they have helped to build an industrial system in which the security of an earlier day has been replaced with the hazard of unemployment. During 1931 and 1932, many scientists, accustomed to working quietly in their laboratories and with little thought for their own economic security, suddenly found their salaries cut in half or their jobs completely gone. Yes, scientists now know that in their own self-defense their methods in the deepest and most spiritual sense must eventually serve the general welfare in the economic and social world.

And so to-day, on the 130th anniversary of the birth of Abraham Lincoln, it is especially encouraging that science is facing the facts concerning the long-run effects of its own past achievements. It is encouraging that science at last is working actively for economic security and is coming actively to the defense of "government of the people, by the people, for the people."

Democracy—and that term includes free science—must apply itself to meeting the *material* need of men for work, for income, for goods, for health, for security, and to meeting their *spiritual* need for dignity, for knowledge, for self-expression, for adventure and for reverence. *And it must succeed.* The danger that it will be overthrown in favor of some other system is in direct proportion to its failure to meet these needs. We may talk all we like about the beauties of democracy, the ideals of democracy, the rightness of democracy. In the long run, democracy or any other political system will be measured by its deeds, not its words.

The survival and the strength of American democracy are proof that it has succeeded by its deeds thus far. But we all know it contains the seeds of failure. I for one will not be confident of the continued survival of American democracy if millions of unskilled workers and their families are condemned to be reliefers all their lives, with no place in our industrial system. I will not be confident of the survival of democracy if economic crises every few years continue to put fear into the hearts of millions of skilled and professional workers. I will not be confident of the survival of democracy if half our people must continue to be below the line of decent nutrition, while only one tenth succeed in reaching really good nutritional standards. I will not be confident of the survival of democracy if most of our children, which means most of our future citizens, continue to be reared in surroundings where poverty is highest and education is lowest.

These are the conditions that made possible what we are now witnessing in certain large areas of the world. They are the seeds of danger to democracy. Given a healthy, vigorous, educated people, dignified by work, sharing the resources of a rich country and sure that their political and economic system is amply meeting their needs—given this, I think we can laugh at any threat to American democracy. But democracy must continue to deliver the goods.

And so, let us dedicate ourselves anew to our democratic body of faith—to the promotion of a stable but ascending general welfare by increasing the productivity of the people and by adopting price, wage and other policies which distribute income more evenly among the people but which do not diminish the incentive to increased production of needed goods. Let us dedicate ourselves anew to the belief that there are extraordinary possibilities in both man and nature which have not yet been realized, and which can be made manifest only if the individualistic yet cooperative genius of democratic institutions is preserved. Let us dedicate ourselves anew to making it possible for those who are gifted in art, science and religion to approach the unknown with true reverence, and not under the compulsion of producing immediate results for the glorification of one man, one group, one race or one nation.

Are we as scientists doing all we can to make democracy succeed? Are we using our science vigorously and impartially, to bring greatly increased health, wealth, security and education to all the people of the United States? The fate of democracy and of scientific freedom will depend less on what we may say than on how unreservedly we dedicate ourselves to these deeds.

OBITUARY

THOMAS WINGATE TODD

January 15, 1885—December 28, 1938

In 1937 there appeared a volume which expressed its purpose "to promote the welfare of the child in the interest of the Nation to the end that physical and mental health, in their fullness, may be added to the ideals of Loyalty, Honor and Service." The book so dedicated, the first of a series, was the "Atlas of Skeletal Maturation (Hand)," by T. Wingate Todd and his associates. In inscription the volume epitomized goal, and in content exemplified a scientific approach. It marked a milestone in bringing human anatomy from the study of charnel house material to the study of the living population.

Trained in the Hunterian tradition that an anatomist must know vertebrate and mammalian as well as human morphology, Dr. Todd was grounded in the comparative approach. To this was added the Egyptology of Sir Grafton Eliott Smith and the human paleontology of Sir Arthur Keith. With this background Dr. Todd built at Western Reserve University a laboratory of anatomy unique in the world: 3,000 skulls and skeletons of the Mammalia; 600 skulls and skeletons of anthropoids; 3,300 human skulls and skeletons, for each of which sex, age and stock (race) was known, and for each of which literally hundreds of anthropometric measurements were available. It was from this comparative and human material that Dr. Todd drew for his many contributions.

Physical anthropology owes to him the insistence that the study of man's body be based on carefully documented material and that it must turn from static problems of evolutionary stage to the dynamic march of unfolding pattern. From the skeletal material he learned those age criteria later to be applied to growth studies: appearance of centers of ossification, calcification of the teeth, union of epiphyses, age-changes in the pubic symphysis and on the articular ends of long bones, suture-closure and age-changes in vascularity and texture, particularly of the flat bones of the skeleton. The measurement of the human body was clarified by his studies of the reliability of locating bony landmarks as related to subcutaneous tissue thickness. He made possible a more accurate transition from craniometry to cephalometry, from osteometry to somatometry: measurement of the dead was for him valid only in so far as it contributed to a more precise measurement of the living.

Human anatomy was to Dr. Todd *living anatomy.* In pursuance of this theme he taught his first- and second-year students gastric function and joint movement via fluoroscopy. A number of papers on the gastro-intestinal tract were published over a period of years. As a distinctly anatomical contribution Dr. Todd edited the chapter on the respiratory system in "Cunningham's Anatomy." At the time of his death he was preparing a volume on clinical anatomy.

With the establishment of the Brush Foundation, in 1928, Dr. Todd, as chairman, began an intensive and extensive study of growth in children. He was concerned not only with the anthropometry of growth, but with maturation—not alone growing, but growing *up* was the theme of his study. Thus it was that his research program embraced the range of physical and psychological investigation: progress in physical maturity and the analysis of increase in size and change in proportion; gain in weight and its relation to the maturation pattern; dento-facial development; brain potentials and muscle action currents; psychomotor development and the unfolding skills; steadiness, dexterity and eye-hand coordination; mental expansion and intellectual and social adjustment; interests, talents and vocational aptitudes; the development of emotional stability and personality traits. Reports treating of these many phases may be found in the Conference on Physical and Mental Growth in the Adolescent, Cleveland, 1930; Part II of the White House Conference on Growth and Development of the Child, 1933; "Atlas of Skeletal Maturation," 1937; and numerous shorter publications.

In recognition of his multifarious interests Dr. Todd served American science in many capacities: associate editor, *American Journal of Physical Anthropology, Child Development, Growth;* vice-president, American Association of Anatomists, 1920–21, 1938–39; vice-president and chairman of Section H, American Association for the Advancement of Science, 1922, 1933; president, American Association of Physical Anthropologists, 1938–39; member, White House Conference on Child Growth and Development, 1929–31. He was honored by membership in the leading anatomical and anthropological societies in the United States, as well as in honorary and scientific fraternities; he held membership in the Société d'Anthropologie de Paris, the Académie Royale de Médecine, Belgium, the Royal Anthropological Institute of Great Britain and the Zoological Society of London. As a civic leader in Cleveland he maintained active membership in many organizations for the promotion of community culture and welfare.

On December 15, 1937, Dr. Todd celebrated his silver anniversary as Henry Willson Payne professor of anatomy at Western Reserve University. It was destined that only one more year was to be added to this quarter-century of achievement, but so productive was he that to him scarcely applied the lines of Keats: "When I have fears that I shall cease to be ere my pen has plucked my teeming brain." Over 250 publications attest to his industry. He was a clear, forceful writer, given to almost lyrical passages; he wrote so that without sacrifice of scientific accuracy he might explain and interpret to the layman. His public addresses were punctuated with humor and adorned with apt phraseology. Seldom have scientist and layman enjoyed a more complete meeting of minds.

American anatomy and physical anthropology have lost a dynamic and far-thinking leader, but they have gained a vision of *living* man as the proper study of man. Generations to come will have life more abundantly for his work. Those of us who knew him and loved him have lost a teacher, colleague and friend.

WILTON MARION KROGMAN
UNIVERSITY OF CHICAGO

RECENT DEATHS AND MEMORIALS

DR. J. PLAYFAIR MCMURRICH, professor emeritus of anatomy at the University of Toronto, died on February 9 at the age of seventy-nine years.

DR. WILLIAM C. KENDALL, who retired in 1932 as aquatic biologist in the laboratory of the U. S. Bureau of Fisheries, died on January 28 at the age of seventy-eight years.

DR. CHESTER DALE CHRISTIE, assistant professor of chemical medicine at Western Reserve University, died on January 27 at the age of fifty-two years.

DR. A. W. PORTER, since 1928 emeritus professor of physics in the University of London, died on January 11. He was a founder member of the Faraday Society and was president of the society from 1920 to 1922.

DR. CHARLES JOSEPH GAHAN, from 1913 to 1927 keeper of the department of entomology of the British Museum (Natural History), died on January 21. He was seventy-seven years old.

PROFESSOR HENRY BALFOUR, curator since 1891 of Pitt Rivers Museum of the University of Oxford, died on February 9 at the age of seventy-five years. Dr. Balfour was a former president of the Royal Geographical Society. He had been a member of the Council of the Anthropological Institute of Great Britain since 1891 and was president of the institute in 1903–04. In 1904 and again in 1929 Dr. Balfour was president of the anthropological section of the British Association for the Advancement of Science.

DR. H. H. WOOLLARD, professor of anatomy in University College, London, died on January 18 at the age of forty-nine years.

THE ninety-second birthday on February 11 of Thomas Alva Edison was observed at the Franklin Institute, Philadelphia, by the opening of several special exhibits, and the attention of visitors was called to permanent exhibits in various sections of the museum connected with Edison's life and work.

THE bi-centenary of the birth of William Herschel, who is called "the father of modern sidereal astronomy," was celebrated in London in January by the Royal Astronomical Society, of which he became the first president in 1820. At that time he was eighty-two years old.

THE Draper Chemical Society of New York University will mark the one hundredth anniversary of the appointment of John William Draper to the chair of chemistry and the chair of physics at New York University by a meeting and exhibit in the Nichols Chemistry Laboratory at University Heights on Tuesday evening, February 21, at eight o'clock. The following addresses will be presented: Professor William West on "The Scientific Accomplishments of John W. Draper," Professor Philip B. McDonald on "The Life of John W. Draper" and Miss Antonia C. Maury on "Personal Recollections of My Grandfather, John William Draper, and of Draper's Family." Miss Maury is curator of the Draper House and Museum at Hastings-on-Hudson. Apparatus used by Draper in his experiments and lectures at New York University will be exhibited together with some of his books and notes, much of it through the courtesy of his granddaughter, Mrs. Dorothy Draper Nye.

IN honor of William Bartram's two hundredth anniversary on February 9, the Academy of Natural Sciences of Philadelphia placed in its library an exhibit of Bartram's books and drawings. Probably Bartram's best-known contribution was his journal, "Travels through North and South Carolina, Georgia and East and West Florida."

SCIENTIFIC EVENTS

SYMPOSIUM OF THE AMERICAN INSTITUTE OF PHYSICS ON TEMPERATURE AND ITS MEASUREMENT

A SYMPOSIUM on "Temperature and its Measurement in Science and Industry" will be held under the auspices of the American Institute of Physics (175 Fifth Avenue, New York, N. Y.) probably next autumn, the dates to be announced later. Consistent with the title, the symposium will cover broadly many fields, its primary purposes, according to present plans, being (1) to coordinate the treatment of the subject in the sciences and branches of engineering; (2) to review principles and bring up to date the record of recent work; (3) to accumulate contributions for a comprehensive text, to be published as soon as possible after the symposium is held; (4) to reveal the subject as an important branch of physics, and (5) to supply schools with the information required for the improvement of curricula. The institute confidently expects that a stimulating, valuable and unified program will be arranged, an aim which will require the help of many contributors.

A representative steering committee has been formed consisting of the chairman, C. O. Fairchild, director of research, C. J. Tagliabue Manufacturing Company; Dr. E. F. DuBois, medical director, Russell Sage Institute of Pathology, and professor of medicine, Cornell University Medical College; Dr. Gustav Egloff, director of research, Universal Oil Products Company; Dr. John Johnston, director of research, U. S. Steel Corporation; Dr. Walter G. Whitman, head, department of chemical engineering, Massachusetts Institute of Technology, and Dr. H. A. Barton, director, American Institute of Physics.

Those who are interested in taking part in this symposium should communicate with the institute at an early date, giving information regarding their field of work and the subject of the contribution they wish to make. Such contributions will be coordinated with the subjects of a group of invited papers and assignments and divisions made. Further information for contributors will be available shortly.

THE BALTIMORE MEETING OF THE AMERICAN CHEMICAL SOCIETY

THE ninety-seventh meeting of the American Chemical Society, under the presidency of Professor Charles A. Kraus, of Brown University, will meet in Baltimore from April 3 to 7. Dr. J. C. W. Frazer, Baker professor of chemistry in the Johns Hopkins University, has been appointed honorary chairman of the meeting, and Dr. John C. Krantz, Jr., professor of pharmacology in the Medical School of the University of Maryland, has been named general chairman. Fifteen symposia reporting advances in scientific research and in the application of chemistry to industry, medicine, agriculture, food, engineering and public health are planned.

Seventeen of the eighteen professional divisions of the society will hold sessions. Details of the program follow:

The Division of Agricultural and Food Chemistry will sponsor a symposium on the Federal Food, Drug and Cosmetic Act, in which the Divisions of Biological Chemistry and Medicinal Chemistry will cooperate. The Division of Medicinal Chemistry will direct a symposium on "Endocrines," in which general papers within the field of medicinal chemistry will be presented.

The Division of Petroleum Chemistry is arranging a symposium on "The Rôle of Catalysis in Petroleum Chemistry,'' under the chairmanship of Professor H. S. Taylor, of Princeton University. Professor Emeritus V. N. Ipatieff, of Northwestern University, will be the guest of honor at a dinner of the division on Tuesday, April 4. He will deliver an address on ''The History of Catalysis and Petroleum Chemistry.''

The Division of Biological Chemistry has scheduled a symposium on ''Vitamins,'' and the Division of Cellulose Chemistry, a symposium on ''American Cellulose in 1939.'' The Division of Industrial and Engineering Chemistry has arranged a symposium on ''Thermal Insulation,'' in which the Division of Petroleum Chemistry will join.

The Division of Chemical Education plans four sessions —one a joint symposium with the Division of Physical and Inorganic Chemistry on ''Theories and Teaching of Acids and Bases''; another devoted to a group of papers on chemical education in high schools; a third, for student papers; and, finally, a session for miscellaneous papers within the field of the division. Hundreds of teachers in the colleges, universities, secondary and elementary schools in the nation will take part.

The Division of Physical and Inorganic Chemistry will present a symposium on ''Fundamentals of Heterogeneous Catalysis,'' with Professor Taylor as chairman. ''The Application of Micro- and Semimicrochemistry to Industry'' will be the subject of a symposium of the Division of Microchemistry, with Dr. G. E. F. Lundell, of the National Bureau of Standards, as chairman.

The Division of the History of Chemistry announces two sessions, one of which, jointly with the Division of Medicinal Chemistry, will be devoted to a symposium on the ''History of Medicinal Chemistry in Baltimore.'' Dr. Henry E. Sigerist, director of the Institute of History of Medicine of the Johns Hopkins School of Medicine, will be a principal speaker. Professor Krantz will present a paper on ''The History of Pharmacology in Baltimore.''

The Division of Rubber Chemistry will feature a symposium on ''Synthetic Rubber and Elastic Polymers.'' Other symposia will include ''Industrial Utilization of Dairy Products'' and ''Colloids and Water and Waste Treatment.''

Six sessions will be held by the Division of Organic Chemistry, four by the Division of Paint and Varnish Chemistry, two by the Division of Sugar Chemistry and Technology, and two by the Division of Gas and Fuel Chemistry.

THE TORONTO MEETING OF THE FEDERATION OF AMERICAN SOCIETIES FOR EXPERIMENTAL BIOLOGY

THE Federation of American Societies for Experimental Biology will meet in Toronto from April 26 to 29. The Royal York Hotel will be the headquarters, and all scientific sessions, motion pictures and state demonstrations will be held in this hotel. The federation is formed by the union of the American Physiological Society, the American Society of Biological Chemists, the American Society for Pharmacology and Experimental Therapeutics and the American Society for Experimental Pathology.

Dr. Glenn E. Cullen, of the University of Cincinnati, will be chairman of the federation by virtue of his election at the recent Baltimore meeting as president of the American Society of Biological Chemists. Dr. Walter E. Garrey is president of the American Physiological Society; Dr. Arthur L. Tatum, of the University of Wisconsin, of the American Society for Pharmacology and Experimental Therapeutics, and Dr. C. Phillip Miller, of the University of Chicago, of the American Society for Experimental Pathology.

The scientific sessions will begin on Thursday morning, April 27. Wednesday will be available for visiting the University of Toronto and other points of interest. The American Institute of Nutrition will meet in the King Edward Hotel, about four blocks away, on this day. On Thursday evening at 9 o'clock the local committee will provide an informal smoker. The annual dinner will be held on Friday evening.

The American Physiological Society will hold two symposia, one on "Carbohydrate Metabolism" and the other on "The Synapse." A joint symposium will be held with the Biochemical Society on "The Red Blood Cells."

Members of the local committee are: Dr. V. E. Henderson, *chairman;* Dr. N. B. Taylor, *secretary;* Dr. E. T. Waters, *treasurer;* Dr. G. E. Hall, Dr. A. M. Wynne, Dr. D. Y. Solandt, Dr. G. H. Lucas, public information; Dr. R. A. Cleghorn, Dr. G. L. Duff, Dr. P. H. Greey, Dr. W. R. Campbell, Dr. J. K. W. Ferguson, Dr. D. A. Irwin, Dr. K. C. Fisher and B. F. Crocker.

THE SIXTH PACIFIC SCIENCE CONGRESS

ANNOUNCEMENT has been made by the National Research Council that the Sixth Pacific Science Congress will be held in San Francisco and vicinity during the period, July 24 to August 12, 1939, under the auspices of the council. The fifth congress in this series was held at Victoria and Vancouver, B. C., in 1933, under the auspices of the National Research Council of Canada, and previous congresses have been held at three-year intervals in other countries of the Pacific region.

Sessions of the sixth congress will be held at Stanford University and at the University of California at Berkeley, as host institutions on this occasion, and certain public functions and other sessions of the congress will be held in "Pacific House" on the grounds of the Golden Gate International Exposition through courtesy of the Department of the Pacific Area of the Exposition. The general arrangements are in charge of the standing Committee on Pacific Investigations of the National Research Council, of which Dr. Herbert E. Gregory, director emeritus of the Bishop Museum in Honolulu, is the chairman. Responsibility for completing the program and for local arrangements is in the hands of a Committee on the Sixth Pacific Science

Congress, especially appointed by the Research Council for this purpose, of which Dr. Charles B. Lipman, dean of the Graduate School of the University of California at Berkeley, is the chairman.

In accordance with the plans of previous congresses of this series, the program of the sixth congress will "emphasize the discussion of comprehensive scientific topics of general interest to the peoples living within the Pacific basin," and the theme of the congress will be "the present stage of knowledge of Pacific scientific problems and methods by which that knowledge may be most profitably enlarged." As the congress is designed for discussion and interchange of ideas rather than for precise formulation of attempted solution of problems, the program is being arranged as a series of symposia rather than as a list of independent papers. Among the subjects to be discussed are:

The Pacific Basin: structure and dynamics; geophysics and geology.
The Pacific Ocean: properties, dynamics and life; oceanography.
Pacific climates, past and present: meteorology, paleontology, paleobotany.
Man and culture in the Pacific region; characteristics, dispersal and development, objectives and results of research; anthropology, human geography and ethnobotany.
Territorial fauna of Pacific islands: characteristics, origin, distribution, human relations; chiefly entomology, malacology and ornithology.
Terrestrial flora of Pacific islands and border lands: characteristics, origin, distribution, human relations; botany.
Classification and utilization of Pacific lands.
Communicable diseases of the Pacific area: origin, history, distribution; tropical medicine.
Nutritional problems of the Pacific area.
Conservation of the marine life of the Pacific Ocean.
Soil resources of the Pacific islands and borders: characteristics, conservation.

Miscellaneous topics:
Facilities and program of institutions interested in scientific studies of the Pacific area.
Means and methods for cooperative research.
Present status of research in Pacific scientific problems and the outstanding problems that merit attention.
General lectures on regions and special topics.

Additional information concerning the congress may be obtained by addressing the secretary-general, Dr. Roy E. Clausen, Room 205 Hilgard Hall, University of California, Berkeley, California.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE AND THE NATIONAL EDUCATION ASSOCIATION

JUST before the meeting in Richmond, on December 24, the officers of the association received the following letter from Dr. Reuben T. Shaw, president of the National Education Association:

> As a fellow of long standing in the American Association for the Advancement of Science, who is now honored with the leadership of the National Education Association, I extend to you the greetings of the nation's teachers and their best wishes for the success of your convention at Richmond.
>
> Scientists and teachers have a community of interest. The scientist discovers truth, the teacher interprets it. We hope that both may cooperate as one profession, interested in aiding man on his road to happiness. In that capacity let us appraise the results of research and investigation, not so much in terms of scientific achievement as in terms of their effect upon the democratic society which the American people have adopted as the Good Life.
>
> It is one thing to shout the alarm that democracy is challenged to-day. That alarm has often been sounded. It is another thing quietly to answer that challenge with the effective weapons that lie in truth and its acceptance and application by mankind. Those weapons are the tools with which the scientist and the teacher work each day. With them let us lay impregnable foundations for the security of free self-government.

By unanimous vote of the council on December 30, the officers of the association sent the following reply to Dr. Shaw:

> The Council of the American Association for the Advancement of Science has received with lively appreciation the friendly greetings of the National Education Association which are conveyed in your letter of December 23. It is a source of satisfaction that two of the largest organizations of teachers and scientists in the world are affiliated and consciously cooperating in the increase and diffusion of knowledge among men. Many of the members of the American Association for the Advancement of Science are teachers, many of the National Education Association are scientists, and in large part the ultimate aims of our two associations are complementary.
>
> With the belief that there can be no permanent progress of mankind except through the discovery and promulgation of truth and that science and education are now the principal means of human progress, the American Association for the Advancement of Science welcomes the cordial cooperation of the National Education Association and in turn desires to offer its support in your efforts to increase and improve education.

SCIENTIFIC NOTES AND NEWS

DR. WILLIAM D. COOLIDGE, director of the Research Laboratory of the General Electric Company, has been awarded the Faraday Medal for 1938 for "notable scientific and industrial achievement" by the council of the British Institution of Electrical Engineers. Dr. Coolidge is the second member of the General Electric Company to receive the medal, the other having been the late Dr. Elihu Thomson.

THE second annual award of the British Institute of Metals has been made to Sir Harold Carpenter, professor of metallurgy in the Royal School of Mines, London, and will be presented to him on March 8. The medal, which is of platinum, is the gift to the council of the institute of the Mond Nickel Company. The first award of the medal was made last year to Sir William Bragg.

THE Meuller Medal of the Science Congress, which opened in Canberra, New South Wales, on January 11, was awarded to Dr. T. H. Johnston, professor of zoology at the University of Adelaide, in recognition of his "outstanding published scientific works."

DR. W. R. DODSON, professor of agronomy in the College of Agriculture of Louisiana State University, was tendered a testimonial dinner on February 2 by the section of animal husbandry of the Association of Southern Agricultural Workers. Dr. H. P. Cooper, president of the association, presided, and Professor J. B. Francioni, Jr., head of the department of animal husbandry at Louisiana State University, was toastmaster. The speakers included: Dr. J. G. Lee, Jr., dean of agriculture, Louisiana State University, and Dr. E. W. Sheets, of the Mississippi State College, chairman of the section of animal husbandry of the association.

THE National Museum of Natural History, Paris, has awarded to Dr. Howard S. Reed, professor of plant physiology at the College of Agriculture of the University of California, a diploma conferring the title of "Correspondant du Museum."

THE degree of doctor of science was conferred on Sir Arthur Stanley Eddington on the occasion of the installation of the Duke of Devonshire as chancellor of the University of Leeds.

IT is announced in *Nature* that Arthur Conway, professor of mathematical physics in University College, Dublin, has been appointed a member of the Pontifical Academy of Sciences to occupy the seat left vacant by the death of Lord Rutherford.

PROFESSOR ARTHUR FREDERICK BERNARD SHAW, who was recently elected to the professorship of pathology at the University of Durham, has been given authority to wear the insignia of Commander of the Order of the Nile, conferred upon him by the King of Egypt in recognition of services rendered by him as professor of pathology in the Egyptian University, Cairo.

WILLIAM ABBETT LEWIS, JR., engineer of the Westinghouse Electric and Manufacturing Company, in Pittsburgh, and a Westinghouse lecturer in electrical engineering at the University of Pittsburgh, has been appointed director of the School of Electrical Engineering of the College of Engineering, Cornell University. The title of emeritus has been conferred on Paul M. Lincoln, who retired in June from the directorship, a position that he had held since 1922. Dr. Lincoln continued as acting director of the school until the appointment of Dr. Lewis as his successor on February 1.

DR. CHARLES D. LUKE, who joined the faculty of the College of Applied Science of Syracuse University in September, 1937, has been appointed acting head of the department of chemical engineering, succeeding Dr. Lloyd Logan, who died in December.

PROFESSOR WALTER P. KELLEY, who has served at the Citrus Experiment Station of the University of California at Riverside since 1914 as professor of agricultural chemistry and professor of soil chemistry, has joined the faculty of the College of Agriculture at Berkeley in the latter capacity and as chemist in the Agricultural Experiment Station.

A BUREAU of Instructional Research has been established at the University of Nebraska, with Dr. J. P. Guilford, professor of psychology, as director. He will continue to devote part of his time to teaching. H. M. Cox, of the University of Georgia, has been appointed to full-time work in the bureau.

PROFESSOR G. R. GIRDLESTONE has tendered his resignation as Nuffield professor of orthopedic surgery at the University of Oxford.

C. C. L. GREGORY, lecturer in astronomy at University College, London, has been appointed director of the observatory.

DR. R. L. SMITH-ROSE has been appointed superintendent of the Radio Department of the British National Physical Laboratory, which includes the Radio Research Station at Slough in addition to the section of the department at Teddington. Dr. Smith-Rose since 1936 has been principal scientific officer-in-charge of the departments.

AT the Long Island College of Medicine, Dr. Cassius Hinds Watson, medical director of the American Telephone and Telegraph Company, has been elected a member of the board of trustees. A graduate of the class of 1905, he succeeds the late Dr. Frederick Tilney, of the class of 1903, as alumni trustee. Health Officer Fred L. Moore has become associate professor in the department of preventive medicine and community health. The development of the work of the department has been made possible by a grant of $43,750 from the Commonwealth Fund.

DR. JAMES K. WILSON, professor of agronomy at Cornell University, who has spent three months making a collection of leguminous plants and of soil bacteria in the West and South, has returned to Ithaca.

J. FRANCIS MACBRIDE, associate curator of the herbarium of the Field Museum, Chicago, who has been in Europe since 1929 obtaining photographs of type specimens of plants in herbaria of various countries, has returned to his headquarters at the Paris Jardin des Plantes, after several months of work in Geneva and Florence. The museum recently received from him about 1,500 additional negatives, bringing the total number in the collection to 36,000. Prints from these are made available at cost to botanists and institutions all over the world.

Dr. C. L. Turner, of the department of zoology of Northwestern University, has leave of absence for the second semester of this year. He will continue his research on viviparous fishes in Mexico.

Dr. H. W. Norris, of Grinnell College, is spending a few months at the Bass Biological Laboratory in Englewood, Fla. He is engaged in further work on the pituitary bodies of sharks and rays. Dr. Madelene Pierce, of Vassar College, expects to spend some weeks at the laboratory, where she will undertake ecological studies of the local fauna.

Dr. Herbert H. Whetzel, professor of plant pathology at Cornell University, sailed on February 10 for Venezuela, where he plans to stay for two months continuing the plant disease and mycological survey of the American tropics. He goes as a collaborator of the U. S. Department of Agriculture, in cooperation with the Venezuelan Department of Agriculture. He will collect fungi and diseased plants to add to the collection of the department. Dr. Carlos E. Chardon, formerly president of the University of Puerto Rico and now in charge of cotton production at Maracay, and Albert S. Muller, plant pathologist at the government agricultural experiment station at Caracas, will take part in the work.

Dr. T. Lynn Smith, head of the department of sociology of the Louisiana State University, has been granted leave of absence for the 1939 summer session to conduct a social and economic survey of Central and South American countries. His survey will be in furtherance of the program initiated last summer for the promotion of greater cooperation between the Americas. A school of Pan-American agriculture, to operate as a unit of the College of Agriculture of the Louisiana State University, is now in progress of organization and, it is expected, will be opened with the 1939–40 session. Representatives of Central and South American governments are cooperating in the organization of the school. A conference with representatives of the U. S. Department of Agriculture is to be held at the university within a few weeks.

Professor Harry S. Smith, head of the division of beneficial insect investigations of the Citrus Experiment Station of the University of California at Riverside, has left for Europe to find parasites of insect pests of the deciduous fruits of California. He plans to visit the Universities of Cambridge and Oxford and the Farnham Royal Laboratory of the Imperial Institute of Entomology, London; the Laboratories of the French Ministry of Agriculture, and the Royal School of Agriculture at Portici, Italy. It is expected that his search will be conducted primarily in France, Italy, Switzerland, Yugoslavia, Hungary, Czecho-Slovakia and south Germany.

Dr. Henry E. Sigerist, William H. Welch professor and director of the Institute of the History of Medicine at the Johns Hopkins University, has been appointed to the South African visiting lectureship for 1939. He will speak at the chief universities of the Union throughout August, September and October and will gather material there and in Egypt for his four-volume history of medicine. He will return in December.

Dr. Jacob Marschak, director of the Statistical Institute of the University of Oxford, spoke at Iowa State College on January 26 on "The Concept of Liquidity" and on January 27 on "Statistical and Economic Research." Dr. Claude E. ZoBell, of the Scripps Institution of Oceanography, La Jolla, Calif., at present visiting professor of marine microbiology in the College of Agriculture, University of Wisconsin, lectured at the college on January 20 on "The Other Two-thirds of the Earth." He gave a second lecture, under the auspices of Sigma Xi, on "The World Below Sea Level."

A joint meeting of the American Philosophical Society and the Franklin Institute is being held in Philadelphia on February 16 and 17. The first day of the meeting at the Franklin Institute was devoted to the commemoration of the life and work of Elihu Thomson. It was held under the auspices of the society and the institute, of the Central High School of Philadelphia, of the Massachusetts Institute of Technology and of the General Electric Company. Among the speakers announced for the afternoon were: Dr. Vannevar Bush, Dr. William D. Coolidge and Dr. Dugald C. Jackson, and in the evening John L. Haney, president of the Central High School, Philadelphia; Roland S. Morris, president of the society, and Dr. Karl T. Compton, president of the Massachusetts Institute of Technology. A film was exhibited showing Professor Thomson in conversation with the late president of the General Electric Company, E. W. Rice, Jr., and there was an exhibition of apparatus invented by Professor Thomson. A symposium on "Progress in Astrophysics" in the Hall of the American Philosophical Society was planned for February 17, the morning session to be presided over by Dr. Harlow Shapley, director of the Harvard College Observatory, and the afternoon session by Dr. W. F. G. Swann, director of the Bartol Foundation of the Franklin Institute. In the evening there will be a lecture by Dr. Henry Norris Russell, professor of astronomy and director of the Princeton University Observatory, on "Stellar Energy and the Evolution of Atoms," at which Roland S. Morris, president of the society, will preside.

THE tenth annual meeting of the American Association of Physical Anthropologists will be held on April 4 and 5 at the Wistar Institute of Anatomy and Biology, Philadelphia.

THE Southeastern Section of the American Physical Society will hold its annual meeting at the University of Georgia, at Athens, on March 31 and April 1. A symposium on biophysics will be a feature of the program at which Dr. Detlev W. Bronk, director of the Eldridge Reeves Johnson Foundation for Medical Physics at the University of Pennsylvania, will be a guest speaker.

THE Midwestern Psychological Association will hold its annual meeting at the University of Nebraska on May 5 and 6, under the presidency of Dr. E. S. Conklin of Indiana University. The title of Dr. Conklin's presidential address will be "The Status of Academic Psychology." A special feature of the meeting will be the commemoration of the fiftieth anniversary of the founding of the psychological laboratory at the University of Nebraska, by Harry Kirke Wolfe.

THE 1938 expedition of the American School of Prehistoric Research was limited to certain parts of Anatolia and Bulgaria. Dr. Dorothy A. E. Garrod, of Cambridge University, the well-known authority on the prehistory of the Near East and leader of the expedition, was assisted by James H. Gaul and Bruce Howe, both former students of the school and at present enrolled in the Graduate School of Harvard University. In the cave of Batcho Kiro, near Drenovo, Bulgaria, they found a stratified paleolithic sequence (Mousterian and Aurignacian), surrounded by a deposit containing pottery and a recent fauna—the first sequence of this kind to have been reported from Bulgaria. With permission of the government and supervision by the National Museum in Sofia, the school will, in the near future, continue the excavations so auspiciously begun at Batcho Kiro.

THE Standards Association of Australia has established a Chemical Industry Committee, the functions of which are coordination and supervision of preparation of standards of chemical analysis and sampling therefor, and standards for materials and products the manufacture of which may be regarded as coming substantially under the heading "Chemical Industry." It will also act as an Advisory Committee to the Council of the Association on all matters relating to chemical industry. The committee consists of representatives of the Australian Chemical Institute, the Australasian Institute of Mining and Metallurgy, educational and government departments and other organizations with chemical interests. Dr. H. B. Taylor has been appointed chairman.

THE Rockefeller Foundation has offered to the University of Oxford £600 for the year 1939 to provide in the department of pharmacology scientific apparatus, laboratory supplies, technical assistance and a fund for current research expenses for investigation on hormones and on the central nervous system.

DISCUSSION

DESCARTES AND THE MODERN WORLD[1]

TO-DAY philosophers and scientists of the world do not hesitate to admit that in the mathematics lies the supreme creation of the human intellect. In every civilization of record the mathematician has occupied himself with the universe of number and of form, the creation of the mind. No external necessity and no practical need determined the developments of mathematical science. However, as developments were made applications were found, and thus, for example, the sciences of astronomy and physics were evolved, in truth, out of the mathematics.

For some thousands of years mathematical science could record a conquest of the material universe in the laws of number and of form largely only upon the assumption of a reasonable universe. Day follows upon day, season upon season, eclipse upon eclipse, in a determinable order; for many centuries the elementary arithmetic and the algebra with the pure geometry of the conics, the circle and straight line were sufficient for such physical measurements as the physicists and astronomers could achieve.

With Viète, Descartes and Fermat, and Leibniz and Newton a wholly new era of mathematics enters into the panorama of intellectual history. In this period the mathematical achievements of the ages are crystallized into systems that give control over the material universe far beyond simple explanation of known phenomena.

Permit an apparent digression, for a moment, to insist that the veritable proof of science lies not simply in the mathematical explanation of known phenomena nor even in the construction of machines. The incontestable proof of reason, the veritable demonstration of science lies in prophetic assertion concerning hitherto unobserved phenomena which lie beyond the control of the prophet scientist.

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[1] A paper presented in Paris, in July, 1937, at the Third International Congress of Philosophy and the Descartes Tercentenary; the author was one of the official delegates of the United States, appointed by President Roosevelt.

Two illustrations must suffice, since the power of the mathematical formulation to explain observed effects to suggest to the competent observer new and unobserved physical phenomena or the creation of new devices in the given field has been repeatedly demonstrated. With Adams and Leverrier you have the proof positive of the adequacy, for that day, of the Newtonian theories in the prophetical mathematical creation of the planet Neptune. The Newtonian laws justified the observed path of the moon, with the exception of certain perturbations. These variations, not consistent with the observed phenomena, could be explained by the postulation of the existence of another planet with an orbit that was derivable from the mathematical equations.

As a second illustration, D'Alembert, using the methods and notations furnished by Viète, Descartes, Newton and Leibniz and others, was able to set up the differential equations which explain the observed phenomena of wave motion. In the hands and mind of Maxwell this led to the electromagnetic theory of light and to Maxwell's prophecy concerning, in common language, "wireless electric waves." It is in the formulas of Maxwell that the radio is prophesied and one may say constructed. Hertz then found the coherer and thus actually detected the rays prophetically constructed by Maxwell; this was equally, as Hertz himself explicitly indicated, the achievement of Maxwell, an unhoped-for gift given by the mathematical formulation. The undeniable proofs of the correctness of Maxwell's equations are furnished finally by the senses in the phenomena whose existence is revealed as a by-product.

It is with some hesitation that I suggest to my philosophical colleagues that mayhap the answer to the ever-recurring question "What is reason?" lies most often in the demonstrations in the world of physical phenomena and must, in some measure, rest upon the material.

The modern mathematics of Viète, Descartes and Newton and the control over the physical universe was made possible by the logical geometry of the Greeks, the arithmetic, the algebra and the trigonometry of the Hindus and the Arabic genius for exposition and combination and extension of the Greek and Hindu material. Particularly the trigonometry to which the Arabs made many independent contributions was essential for the subsequent control over the physical universe.

To-day one can say, without hesitation, that in these developments that were transmitted to Europe by the Arabs the mathematical science of Egypt and Babylon contributed no mean and insignificant part.

The transmission to Europe of the science of the Orient and the near East was effected over several centuries by Latin and Hebrew translations. The universities were created to a large extent, as Sarton has indicated, to make possible the systematization of the tremendous mass of scientific material revealed to Europe in the translations.

Italy played a most important role in the development of algebraic techniques and notably in the algebraic solution of the cubic and bi-quadratic. In an attempt to systematize these solutions Viète created the literal symbolism, the initial and crucial step towards a new mathematics.

Without Viète there could be no Descartes and Fermat; without Viète, Descartes and Fermat, there could be no Newton and Leibniz.

Recall that the symbolism of Newton is a variation of Viète's literal symbolism employing the fluxion overhead dot; the Leibniz $\frac{dy}{dx}$ is another variation of the Viète literal symbolism. To the philosopher the paradoxes and the difficulties of the infinitesimal and the infinite cause a great deal of trouble; witness the papers of this congress. For philosopher and mathematician no solution is possible without some mathematical symbolism. For the application of mathematics to physical problems the infinitesimal calculus with some adequate notation is the only known road.

What is the part of Descartes in the progress of the mathematical control of the universe? In truth one can say that the analytical geometry is the application of the literal symbolism to geometry, the necessary first step towards the application of algebraic methods to physical phenomena.

Descartes' use of Viète's symbolism revealed that the literal symbolism (of x, y and r or v) was equally powerful in trigonometry. Upon this followed also, as Professor Elie Cartan, of Paris, has so well shown, the introduction into geometry of imaginary elements. The literal symbolism in the real plane made the $x + i.y$ symbolism of the complex plane an inevitable continuation. The interplay here between the algebra of real quantities, the algebra of complex numbers and the geometry and the trigonometry made possible mathematical developments of the greatest importance for the domination of the physical universe.

The fundamental importance of trigonometry in the progress of mathematical science has not been sufficiently recognized by historians of mathematics. To apply the mathematics to physical phenomena it was absolutely essential to have mathematical expressions for recurrence. The Hindus, by a stroke of genius, dropped the Greek trigonometry of chords and introduced the half-chord or sine function. With the shadow function of the Hindus, further developed by the Arabs and Europeans, one has a trigonometry adaptable to simple mathematical formulations, as Viète demonstrated in so masterly a fashion. This trigonometry leads back again to algebraic formulations employing the complex numbers; it is sufficient here to mention the names of Demoivre and Euler and Gauss. Progress in early mathematical science hinged upon this constant interplay between algebra and geometry. This was the path, also, that made possible the application to physical phenomena. It is for that reason that one can say that Viète, Descartes and Fermat, Newton and Leibniz created the modern world in which recurrent phenomena, not only the wave motion of the mathematician, but also "quantity production" made possible in industry by such phenomena, play so important a role.

In conclusion I must recur to a point of view mentioned by Professor Elie Cartan, *i.e.*, that there are those who deny to Descartes the invention of the analytic geometry. The opinion of Coolidge,[2] that the Greeks invented analytic geometry, is characterized, possibly by a slip of the pen, as "une des opinions les moins déraisonables."[3] I prefer to phrase it as "les plus déraisonables." This assertion by Coolidge is an absolute denial of progress in science. This is, it seems to me, of a piece with that madness that would characterize all science as Greek or as Aryan. If you say that the Greeks had the analytic geometry, what becomes of all that majestic work done by the Hindus, systematized and transmitted by the Arabs, and worked over again by generations of Europeans, culminating in Viète, Descartes and Newton. Science is progressive; mathematical science is the indisputable achievement of the human intellect of all the ages past and of all peoples, including Moslems and Jews and Christians and followers of other gods.

The modern world of electricity, of the aeroplane, of quantity production and of the wireless was made possible by the mathematical formulas of the literal algebra, the analytical geometry, the trigonometry and the calculus with their derivative sciences. The new mathematics made it possible not only to explain the observed phenomena but to create a new material world quite different from the old world. In the process of transition many have forgotten and some would even deny the mathematical creation. The progressive character of this creation has made it easy to forget the creator.

In mathematics one can not leap from the Greeks to Newton and Leibniz. There is only one intellectual highway to the modern mathematics and that leads, as I have indicated above, through the intellectual accomplishments of the Hindus and Arabs, by the way of the Jewish and Christian translators of the Arabic and the Greek, through Europe of the middle ages and the renaissance to those majestic men of science, Viète, Descartes and Newton. Their work crystallized the mathematical achievements of all past ages; no nation can claim them; in any age of reason these men belong to humanity.[4]

LOUIS C. KARPINSKI

AUTHORITY CITATIONS IN NOMENCLATURE

THE discussion of authority citations raised by Donald Culross Peattie and continued by others seems, thus far, to have been confined to workers in modern biology. The problem is even more acute in the fields of paleontology and paleobotany where species are often necessarily established on form rather than on phylogenetic bases, as well as on fragmentary remains. Later evidence may require one or more subsequent changes to be made in the classification of a species, in which case a full citation of authorities becomes impossible.

A case in point is that of the Carboniferous fossil fern originally called *Staphylopteris sagittatus* Lesquereux, described and figured in the Report of the Geological Survey of Illinois, Volume IV, 1870. Ten years later Lesquereux himself had cause to refer this species to a new genus, and the change was published in the Report of the Second Geological Survey of Pennsylvania, Vol. 1, 1880. To be actually complete, the name and authority would have to be cited as *Sorocladus (Staphylopteris) sagittatus* (Lesquereux) Lesquereux. A further study of the species was next made in 1902 by Sellards, working in Kansas, who found that the species should be referred to the genus *Crossotheca* Zeiller. This change was published in the *American Journal of Science,* Vol. IV, 1902. Obviously, a complete citation of authorities after the name would be awkward. Consequently, the name is usually cited by paleobotanists merely as *Crossotheca sagittata* Lesquereux, credit being given to the original author without reference to the several authors of the generic changes. Examples of this nature are numerous, and it can be seen at once that a change in authority with every change in classification would lead to disassociation of a given species from its original description. This would lead to endless confusion, especially among younger workers in the field who have not had the opportunity of becoming thoroughly acquainted with the ever-increasing literature in the respective fields.

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[2] See J. L. Coolidge, *Osiris,* I, pp. 231–250, 1936.

[3] Elie Cartan, *Actualités scientifiques et industrielles,* 585: 146–153, 1937.

[4] See also: B. de Kerékjártó, *Actualités scientifiques industrielles,* 535: 166–173; Casimir Wize, the same, pp. 144–146; M. Abel Rey, the same, 531: 27–32.

The greatest burden to the research worker is the necessity of tracing a species through the maze of national, local and foreign literature bearing upon a particular subject. Only at very large institutions is most of this literature available for use. The worker in smaller institutions or remote localities is handicapped by not having thousands of publications readily accessible to him. A step toward the solution of the problem was made by David White, who maintained a private catalogue of paleobotanical nomenclature covering the Paleozoic Era during his lifetime. The work was never published; however, specialized catalogues of similar natures have been published by various authors in the past, but these soon become out of date. The time and cost of such work does not allow for private revision as often as desirable.

It seems that the establishment of a national or international bureau of registration for nomenclature of biological and paleontological names is necessary for the satisfactory conclusion of the problem. When once established, it should be made mandatory for every author to register at this bureau his new species or generic changes, together with references to the publications in which they appear. Failure to register would invalidate the work. In this way, authors could continue to publish their works in various well-known or obscure publications, as at present, but all references to such works would become readily available to other workers by reference to the central bureau acting as a "clearing house." Workers in remote localities, where vast amounts of literature are not available, could obtain pertinent references by application to the bureau; and on the other hand, work which they accomplish would become recognized elsewhere immediately upon publication. Needless to say, countless hours of work would be saved the research worker who, under present conditions, must spend the greater part of his time tracking down references.

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POLYCHAETE ANNELID WORMS IN THE GREAT LAKES

A number of years ago, O. L. Meehean[1] reported finding a minute (2.9 mm), transparent polychaete annelid worm in Duluth Harbor. In the summer of 1936 I found a single specimen of what is very probably the same worm in Lake Erie at a depth of 55 feet, in the open lake approximately 30 miles due east of Put-in-Bay, and during this past summer I obtained additional specimens from the same locality. Since these worms have been found in both Lake Superior and Lake Erie, it is highly probable that they are quite generally distributed throughout the Great Lakes. Needless to say, the occurrence of a polychaete annelid in these lakes is a matter of interest, since the Polychaeta compose an almost exclusively marine group, of which very few species have been reported from North American fresh waters. In 1858, Leidy[2] described a sabellid polychaete from the Schuylkill River at Philadelphia, which he named *Manayunkia speciosa.* Later, with additional specimens from Egg Harbor River, N. J., he gave a more complete description. Early in the present century, Johnson[3] described nereids from California, and more recently Olga Hartman[4] has added others from the same region.

Comparison of my Lake Erie polychaetes with Meehean's description of his Lake Superior specimens leads me to think the worms are the same, an opinion with which Meehean agreed in conversation. He had previously referred his specimens tentatively and with some doubt to Leidy's species. The Lake Erie worms agree sufficiently with Leidy's description and figures to warrant placing them in the genus *Manayunkia,* but they differ so sharply in certain important features that it appears very doubtful whether they belong to the species Leidy described. For instance, he mentions and figures a pair of haemal loops in each segment which do not occur in the specimens from the Great Lakes. At the anterior end of these latter specimens there is an open collar which surrounds the base of the tentacles. Leidy states that the border of the head "projects dorsally into a rounded process," but he makes no mention of an open collar. The arrangement of the tentacles also differs. Leidy describes a pair of lateral lophophores, each of which bears a double row of tentacles. In the Lake Erie specimens there is a pair of lateral lophophores on each side of the head, the tentacles of which are not arranged in two regular rows in the manner described and shown by Leidy.

Leidy's well-sustained reputation for accuracy in observation and description lends weight to the significance of the discrepancies between his description of *Manayunkia speciosa* and the conditions found in the specimens from the Great Lakes. In view of the discrepancies and pending a more detailed description which is being prepared, I propose to designate the worms from Lake Erie as *Manayunkia eriensis.*

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[1] O. Lloyd Meehean, Science, 70: 479, 1929.

[2] Jos. Leidy, *Proc. Phila. Acad. Nat. Sci.,* 1858, 90; 1883, 204.

[3] H. P. Johnson, Mark Ann. Vol.: 205, 1903.

[4] Personal letter.

ELLIPTICAL ERYTHROCYTES

IN reply to the note of Terry[1] regarding the erythrocytes of the "sloth," the description by Gulliver[2] apparently need not be questioned. Examination of red blood cells in sections of various organs of several species of Edentata (*Cholopus didactylus,* the two-toed sloth, *Bradypus tridactylus,* the three-toed sloth, anteaters and armadillos) and of other types of mammals including four species of Camelidae, as well as many species of birds, shows that the morphology of these cells is sufficiently characteristic to prevent confusion. The erythrocytes of the sloths are, as in mammals generally, circular, bi-concave discs, while those of Camelidae are oval and convex. Incidentally, Gulliver[2] noted that the erythrocytes of llamas have a greater length-width ratio than those of camels, that, in certain Cervidae, these cells often are very irregular in shape, and that, in Edentata, they are among the largest found in mammals. This author also was aware that characteristic shape of red blood cells might be altered by disease. In captivity, the sloth usually is not a hardy animal. Perhaps Schartum-Hansen[3] encountered a description of blood cells from a diseased animal, although he does not give references.

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SCIENTIFIC BOOKS

TEXT-BOOKS IN PHYSICS

Physik. PAUL WESSEL. Pp. xii + 504. Reinhardt, München, 1938. RM 4.90.

College Physics. HENRY A. PERKINS. Pp. ix + 820. Prentice Hall, 1938. $3.75.

The Elements of Physics. ALPHEUS W. SMITH. Pp. xix + 790. McGraw-Hill, 1938. $3.75.

An Outline of Physics. ALBERT E. CASWELL. Pp. ix + 590. Macmillan, 1938. $3.75.

Glossary of Physics. LEROY D. WELD. Pp. vi + 255. McGraw-Hill, 1937. $2.50.

Physics for Technical Students. 2 Vols. W. B. ANDERSON. Pp. vii + 795. McGraw-Hill 1937.

Sound Waves and Acoustics. M. Y. COLBY. Pp. ix + 356. Henry Holt, 1938. $2.80.

Experimental Physics, A Laboratory Manual. S. W. WILLIAMS. Pp. 158. Ginn and Co., 1937. $1.00.

A First Course in Physics for Colleges. MILLIKAN, GALE and EDWARDS. vii + 712 + lxii, 1938. $4.00.

Introduction to College Physics. C. M. KILBY. Pp. x + 398. Van Nostrand. 1938. $3.25.

Elementary Practical Physics. BLACK and DAVIS. Pp. ix + 710. Macmillan, 1938. $2.00.

Physics of To-day. CLARK, GORTON and SEARS. Pp. vi + 633. Houghton, Mifflin, 1938. $1.80.

THE teaching of physics depends on three factors, the teacher, the laboratory equipment, the text-book. The teacher, master of his subject and of the techniques connected with it, given a reasonable appropriation, will see to it that the laboratory equipment is ample. He may find any one of several texts satisfactory; even a condensed syllabus may serve his purpose. Clear in voice, logical in arrangement, with experimental demonstration at his finger tips, masterful in presentation, he should be the inspiring factor. But a good text-book would help.

The text-books listed above are arranged more or less in order of the domain of general physics which they cover, not in order of the number of pages. The German text presents the entire subject, as we understand it in this review, in 354 pages (9 × 16 cm). Then to condense it still further it is gathered into 60 pages in a "kurtzes Repetitorium and Formelsammlung." This is followed by 60 pages of tests "Prufungsfragen und Antworten." It is similar to a catechism. A question is asked, the page on which the answer can be found is given. "Wie lauted das Daltonsche Gesetz? (S55)." "Was verstehl man unter Verdunstungkälte? (S87)." "Welches sind die Grundedanken der Quantheorie? (S348)." There are 1,447 such questions and answers. It is seen that these are non-computational questions. Numerical and algebraical illustrations are given in the body of the text. Finally, there are 40 pages of physical tables making the text a veritable handbook. Every artifice is employed by means of changes of type, capitals, bold-faced type, italics and by graphs of all kinds to emphasize and explain.

The next two texts are of the same order of completeness as the German text, but after the American manner of college texts in general physics. Professor Perkins's text is a first edition. A student will look at its 820 pages (10.5 × 17 cm) with apprehension. Can he master its contents in one college year? Probably not. Yet some teachers will value it for its completeness, others will reject it as a text to be used in their classes for the same reason.

The author maintains a high level throughout the book, and its compilation represents an intensive labor long continued. The last chapters dealing with modern physics are up-to-date and are among the best in the book. At times the reviewer has the feeling that the presentation is didactic rather than being based on experimental evidence. At times an extremely important point receives scant treatment. Take, for example, the treatment of the law of gravitation. It is stated that "the gravitational attraction between two bodies is proportional to the product of their masses and is inversely proportional to the square of the distance between them." As this statement stands "the distance between them" has no meaning, and the statement is incorrect. The law should have been stated thus: "Every particle of matter attracts every other particle. . . ." Then it could have been pointed out, though this should have preceded the statement of the law, that one of the great contributions made by Newton was in proving that under the law of the inverse square the combined action of all the infinite number of particles of a uniform sphere upon a particle outside of it is equal to that of the whole mass of the sphere at its center. Only then are we justified in saying that the distance of the moon from the earth is 60 times the distance of an apple from the earth Kepler's laws based upon experimental evidence then should replace the myth of the apple. The law of universal gravitation for every particle would follow.

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[1] M. C. Terry, SCIENCE, 88: 475, 1938.

[2] George Gulliver, *Proc. Zool. Soc., London,* p. 474, 1875.

[3] H. Schartum-Hansen, *Acta Medica Scandinavica,* 86: 348, 1935.

The text is amazingly free from blunders and errors, but there is one fallacy. It is a fallacy which appeared about ten years ago in a text on modern physics and which has been adopted by various authors since then It concerns the proof that light exerts pressure. The reviewer called attention to this fallacy and other fallacies in texts on modern physics a few years ago.

There is no padding in these eight hundred and more pages. There is no full-page photograph of the *Queen Mary* with joyous passengers on the decks waving to friends on shore, of monkeys describing parabolas as they leap from bough to bough, of Miss America in a one-piece bathing suit looping the loop on a bicycle. Practically no space is given to useless arithmetical computations, useless because they are of eighth-grade difficulty. The wording is direct, concise, clear. That this text is longer than any other in English with which the reviewer is acquainted is due to the fact that it deals with more topics than any other text. But what will the physics text of fifty years hence be like?

Professor Smith's text is the fourth edition; the first edition appeared in 1923. It has been greatly extended, new material has been added, there has been a change of emphasis in the older topics. A new chapter, an excellent one, on nuclear physics has been added. Then the author, feeling that 740 pages are not enough, adds another chapter on modern astronomy. But though relatively obsolete material has been discarded to make way for the new, we still find the antique ideas about levers of the first, second and third class. It appears that some writer of a textbook in physics back in the ages when the subject was young, desiring to fill up his book and to display a high sense for organization, set forth the above classification, and it has been repeatedly followed since.

Arithmetical solutions of problems, sometimes of an extremely elementary character, appear on almost every page. A formula has just been derived, the arithmetical values are substituted in the formula, the problem is solved. The student is excused from exercising his brain or of visualizing the phenomenon. Physics becomes something that is in a book. Thus

> *Example*—What force is necessary to give a mass of 10 lb. an acceleration of 3 ft. per second per second? Force in poundals = mass in pounds × acceleration in feet per second per second.
>
> $$F = ma$$
> $$= 10 \times 3 = 30 \text{ poundals.}$$

And what does the student know about 30 poundals? For many years the reviewer has ruled out that kind of solution. He has told his students that frequently a formula is used in order to conceal one's ignorance. Here is the solution that the reviewer would accept. "Ten pounds (grams or tons) force gives to 10 lbs (grams or tons) mass an acceleration of 32 ft. per sec. per sec. (Definition of a pound (gram or ton) force). Hence an acceleration of only 3 ft. per sec. per sec. would require only 3/32 of ten lbs. (grams or tons) force." The student knows what the answer means. No formula is required, none should be used.

There are not only some 780 pages in Professor Smith's text, there are 784 figures, some of them in two or three sections; there are also 9 full-page plates, some of them in color. This illustrates the great importance of visual aids in the teaching of physics. These visual aids supplement the classroom demonstrations of apparatus and of experiments; to these may be added moving pictures in slow motion. Text-book, teacher, student, all must emphasize the importance of an appeal to the eye. The great number of figures and plates in this text not only have a positive value as visual stories, they also have a value in making the text less terrifying to the student than it otherwise would be.

A physicist is probably an uncomfortable companion at any time. He may claim to know or want to find out cause and effect. But a physicist reviewing books may be looked upon as one in an excited state; and like an atom in that condition he is apt to emit a quantum of irritation upon seeing an error. In this case it is in "Fig. 267. Distribution of velocities." It should have been *speeds*. Hairsplitting? Not at all in this case. The curve for *velocities* is entirely different from that for *speeds*.

Professor Caswell's book is a second and greatly revised edition. The order of topics in the first edition (1928) was regarded as abnormal by many physicists. The new order is more nearly normal. The number of pages has been *reduced* from 773 to 590! This has been accomplished partly by omitting several topics in modern physics (only 40 pages as against 100) and by limiting the topics in mechanics. There are no positrons or neutrons, there is no heavy hydrogen, no artificial transmutation or radioactivity, practically nothing about cosmic rays, no cyclotrons, in this text. With these exceedingly important items omitted one wonders why space should have been given to the theory of relativity.

The first thirty or forty pages of this text are in the form of a glossary—physical terms are defined or very briefly discussed, mass, temperature, force, electron, atomic numbers. Now a glossary similar to the next book in this list is a very satisfactory volume in the office of a journalist or even in a physics library, but no teacher would use it as a text-book. The reviewer believes that a physical term should be introduced only when the phenomenon involving the term is being demonstrated and studied. And here we note that the old picture of the atom is retained, the picture that was discarded in 1932 after the discovery of the neutron. Our new picture now presents the nucleus as composed of protons and neutrons, not protons and electrons (hydrogen one proton). The definition of atomic number is now the number of protons in the atom, not the number of electrons in the shells, we may take away an electron or neutron, but we can not take away a proton without changing the atomic number. It is not the energy of any one electron but the *maximum* energy of the electrons having a metal under the influence of light which depends only on the frequency of the light and the kind of metal.

In the body of the book the statements are clear, the illustrations numerous and apt, there are review questions and problems at the end of every chapter.

The glossary by Professor Weld began with a collection of definitions in card catalogue form kept in his office in Coe College. The Division of Physical Sciences of the National Research Council appointed an advisory committee to work with him to revise and, if necessary, extend this list, but its chairman, Professor Weld, has been the responsible compiler. Some 3,500 or 4,000 terms occurring in physics texts and periodicals are listed. Obviously this book would be an important volume in the library of a physics department. Many instructors in physics, journalists, science editors, will want to own one. But this reviewer seems hard to suit. Opening the book at random he reads a definition "*Fresnel rhomb*—A rhombic glass prism so shaped that a ray of plane-polarized light entering by one face emerges from the opposite face after two internal reflections and is thereby elliptically polarized." The Standard Dictionary says *circularly* polarized. But it may emerge plain, circularly or elliptically polarized. The original function of the rhomb was to produce circular polarization. Again at random the reviewer finds the definition of *photoelectric* not to his liking. The definition excludes the action of the so-called photronic cell, which is the outstanding photoelectric device of to-day. That cell is included under the term photovoltaic. The reviewer would make this term a subdivision of the former and would define "photoelectric effect—an effect due to the absorption of a quantum of radiant energy by an electron in such a way as to release the electron from its restraints, thus giving rise to a voltage or a current or a decrease of resistance." This would include *photovoltaic, photoelectronic, photoresistant.*

Professor Anderson's text is a third edition. It is only slightly more technical than the first two texts on this list. It is a little more concerned with engines of various sorts and devotes a total of only one page to several items of modern physics, neutrons, positrons, cosmic rays, transmutation of the elements.

The subject of sound has had a rebirth during recent years. By electrical means we are able to produce and to record sounds of any frequency and of any intensity. The telephone, microphone, sound film, public address system, are of great importance in human affairs. Professor Colby's book is written in recognition of this fact. Gently instructing the student in the mysteries of the sine curve, Newton's laws, ordinary mechanics, wave motion and other elementary matters, he proceeds to the discussion of the Rayleigh disc, phonometers, pressure microphone, piezo-electric oscillators, decibels and modern devices. Architectural acoustics as developed by Sabine, Watson and Knudson, auditory sensations and reactions as developed by Fletcher, Wente and other workers in the Bell Laboratories feature the closing chapters.

The Millikan-Gale-Edwards volume is a successor to various other texts by these or some of these authors. It is decidedly up-to-date. The frontispiece shows cloud tracks of positive and negative electrons from cosmic ray nuclear encounters and the last plate is labeled neutron tracks. (But neutrons leave no tracks! The authors should have labeled it—"Tracks of ions produced by neutron bombardment.")

This text contains 712 pages of type, about 600 diagrams and 94 full-page photographs or plates, "portraits of physicists and illustrations of recent achievements in physics." It is this last feature that distinguishes it from all the texts and makes it an exciting book. Do you want to see at a glance the progress of artificial lighting from the early torch to the modern incandescent lamp? Here is a full-page plate giving lamps and dates, the torch, pre-historic, stone lamp 3000 B.C., metal lamp A.D. 400, oil lamp 1600; 1879, Edison's first lamp 1.4 lumens per watt . . .; 1913, gas-filled lamp 20 lumens per watt. . . . The Hammond organ, air-conditioning Pullman cars, the world's largest telescope and mirror, the Rocket 4¼ tons and the Virginian Mallet 450 tons, side by side, lightning striking the Empire State Building. . . . There is perhaps a straining after "the world's greatest . . ." sometimes the student will learn no physics from the picture, but he will be interested and he may ask questions; certainly he will gain information.

Professor Kilby's book is a second edition (first, 1929). As the number of pages shows, it is a brief course in fundamentals. It is conservative and practical, orthodox and logical in its arrangement, direct and clear in statement, up-to-date in regard to neutrons, protons, electrons and atomic structure. It will answer the needs of many instructors giving a three-hour first course in physics.

Coming to high-school texts we have the book by the reminiscent combination, Black and Davis. Like the Millikan, Gale and Edwards text it has many figures (492), many photographs (116). As might be expected of these authors, the photographs are of up-to-the-minute affairs, the stratosphere balloon and gondola, radio meteorograph, electric refrigerator, rock-wool insulation, the cyclotron. Sometimes full use is not made of the photographs. Here is one of a tug of war between a 7,200-pound elephant and a tractor. But the weight of the latter was not given, nor the coefficient of friction in either case. Why not the draw-pull of each? (The tractor won.) The text is a study in pedagogy as well as in physics. It is inductive in method, emphasizes physical principles by illustrations from daily life, uses various styles of type to emphasize main points, qualitative questions and arithmetical problems follow each chapter, there are frequent summaries and reviews.

The Clark, Gorton, Sears text is very much like the Black and Davis, only more qualitative. Here again diagrams and photographs are much in evidence. There are 750 of these, together with several photographs of physicists. Some of the photographs of apparatus are out of the ordinary. Here are eight photographs which might be labeled "How to operate an airplane." Here are eight diagrams illustrating airplanes stunting—"A snap roll," "A chandelle," "An Immelman roll." There are several other photographs of airplanes. Obviously all these are for display or for arousing interest.

Again there is interest in the pedagogical aspect. There are previews of units, questions preceding every chapter to arouse the interest of the student, and at the end of each chapter exercises (qualitative questions and problems) and a summary.

The treatment everywhere is exceedingly elementary.

Gordon Ferrie Hull

SOCIETIES AND MEETINGS

THE AMERICAN CHEMICAL SOCIETY

Election of 126 chemists to administrative and editorial posts in the American Chemical Society, which has a membership of more than 22,000, was announced recently. The society's eighteen professional divisions named officers for 1938–39, and editors of five scientific publications were chosen. The divisional officers are:

Division of Organic Chemistry: Chairman, Werner E. Bachmann, of the University of Michigan; *secretary,* Ralph L. Shriner, of the University of Illinois; *executive committee,* in addition to officers and ex-officers, Charles F. H. Allen, of the Eastman Kodak Company, Rochester, N. Y.; Louis F. Fieser, of Harvard University; Lyndon F. Small, of the University of Virginia.

Division of Physical and Inorganic Chemistry: Chairman, George Scatchard, of the Massachusetts Institute of Technology; *chairman-elect,* G. Frederick Smith, of the University of Illinois; *secretary-treasurer,* Harold C. Urey, of Columbia University; *on executive committee,* Harold S. Booth, of Western Reserve University; George S. Parks, of Stanford University.

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Division of Medicinal Chemistry: Chairman, Walter H. Hartung, of the University of Maryland; *vice-chairman,* Frederick Fenger, of Armour and Company, Chicago; *secretary,* Russell J. Fosbinder, of the Maltbie Chemical Company, Newark, N. J.; *on executive committee,* George D. Beal, Mellon Institute of Industrial Research, Pittsburgh.

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Division of Agricultural and Food Chemistry: Chairman, Roy C. Newton, of Swift and Company, Chicago; *vice-chairman,* Charles N. Frey, of the Fleischmann Laboratories, New York City; *secretary,* Gerald A. Fitzgerald, of the Birdseye Laboratories, Boston; *on executive com-*

mittee, R. Adams Dutcher, of Pennsylvania State College; C. R. Fellers, of Massachusetts State College; H. R. Kraybill, of Purdue University; R. C. Sherwood, General Mills, St. Paul, Minn.

Division of Petroleum Chemistry: Chairman, Per K. Frolich, of the Standard Oil Development Company, Elizabeth, N. J.; *vice-chairman,* J. K. Roberts, of the Standard Oil Company, Chicago, Ill.; *secretary-treasurer,* Cary R. Wagner, of the Pure Oil Company, Chicago; *on executive committee,* Frank W. Hall, of The Texas Company, New York City; Jacque C. Morrell, of the Universal Oil Products Company, Chicago.

Division of Colloid Chemistry: Chairman, Lloyd H. Reyerson, of the University of Minnesota; *vice-chairman,* Ernst A. Hauser, of the Massachusetts Institute of Technology; *secretary-treasurer,* Arthur M. Buswell, of the University of Illinois; *on executive committee,* Herbert L. Davis, of the Institute of Paper Chemistry, Appleton, Wis.; Robert C. Williams, of the Ironsides Company, Columbus, Ohio; Geoffrey E. Cunningham, of Clarkson College of Technology, Potsdam, N. Y.; Ross A. Gortner, of the University of Minnesota; Wesley G. France, of Ohio State University; E. J. Miller, of the Michigan Agricultural Experiment Station, East Lansing, Mich.

Division of Cellulose Chemistry: Chairman, George L. Clark, of the University of Illinois; *vice-chairman,* Melville L. Wolfrom, of Ohio State University; *secretary-treasurer,* William O. Kenyon, of the Eastman Kodak Company; *on executive committee,* Elwin E. Harris, of the Forest Products Laboratory, Madison, Wis.; William F. Henderson, of the Visking Corporation, Chicago.

Division of Rubber Chemistry: Chairman, G. K. Hinshaw, of the Goodyear Tire and Rubber Company, Akron, Ohio; *vice-chairman,* E. B. Curtiss, of R. T. Vanderbilt Company, New York City; *secretary,* Howard I. Cramer, of the University of Akron; *treasurer,* C. W. Christensen, of the Rubber Service Laboratories, Akron; *executive committee,* Archie R. Kemp, of the Bell Telephone Laboratories, New York City; James C. Walton, of the Boston Woven Hose and Rubber Company, Boston; Arthur W. Carpenter, of the B. F. Goodrich Company, Akron; George S. Haslam, New Jersey Zinc Company, Palmerton, Pa.; W. G. Nelson, United States Rubber Company, Detroit, Mich.; Carroll C. Davis, of the Boston Woven Hose and Rubber Company; Seward G. Byam, of E. I. du Pont de Nemours and Company.

Division of Sugar Chemistry and Technology: Chairman, A. R. Nees, of the Great Western Sugar Company, Denver, Colo.; *vice-chairman,* James M. Brown, of the Revere Sugar Refinery, Charlestown, Mass.; *secretary-treasurer,* Edgar W. Rice, of the National Sugar Refining Company of New Jersey, New York City; *on executive committee,* Horace S. Isbell, of the National Bureau of Standards, Washington, D. C.; John C. Keane, of the Utah-Idaho Sugar Company, Salt Lake City, Utah; Raymond M. Hann, of the National Institute of Health, Washington, D. C.; Carl C. Kesler, of Penick and Ford, Cedar Rapids, Iowa; Marshall T. Sanders, of the Atlas Powder Company, Wilmington, Del.

Division of Microchemistry: Chairman, Lawrence T. Hallett, of the Eastman Kodak Company; *vice-chairman,* Clyde W. Mason, of Cornell University; *secretary-treasurer,* George L. Royer, of the Calco Chemical Company, Bound Brook, N. J.; *on executive committee,* Frank Schneider, of Rutgers University; Walter R. Kirner, of the Carnegie Institute of Technology, Pittsburgh.

Division of Paint and Varnish Chemistry: Chairman, William H. Gardner, of the Polytechnic Institute, Brooklyn, N. Y.; *chairman-elect,* Edwin J. Probeck, of the Jones-Dabney Varnish Company, Louisville, Ky.; *secretary-treasurer,* G. G. Sward, of the National Paint, Varnish, and Lacquer Association, Washington, D. C.; *on executive committee,* E. E. Ware, of the Sherwin-Williams Company, Cleveland; Gordon M. Kline, of the National Bureau of Standards, Washington, D. C.; Lawrence K. Scott, of the Jones-Dabney Varnish Company.

Division of Gas and Fuel Chemistry: Chairman, Frank H. Reed, of the Illinois Geological Survey; Urbana, Ill.; *vice-chairman,* H. C. Hottel, of the Massachusetts Institute of Technology; *secretary-treasurer,* Gilbert Thiessen, of the Koppers Company, Pittsburgh; *on executive committee,* R. E. Gilmore, of the Canadian Bureau of Mines, Ottawa; O. O. Malleis, of the Appalachian Coals Company, Cincinnati.

Division of Fertilizer Chemistry: Chairman, Egbert W. Magruder, of the F. S. Royster Guano Company, Norfolk, Va.; *secretary,* H. B. Siems, of Swift and Company Fertilizer Works, Chicago; *on executive committee,* F. B. Carpenter, of the Virginia-Carolina Chemical Corporation, Richmond, Va.; H. R. Kraybill, of Purdue University; F. W. Parker, of the du Pont Ammonia Corporation, Wilmington, Del.; W. H. Ross, of the Bureau of Chemistry and Soils, Washington, D. C.

Division of Water, Sewage, and Sanitation Chemistry: Chairman, A. P. Black, of the University of Florida; *vice-chairman,* O. M. Smith, of the Oklahoma Agricultural and Mechanical College; *secretary-treasurer,* Charles R. Hoover, of Wesleyan University; *on executive committee,* R. C. Bardwell, of the Chesapeake and Ohio Railway Company, Richmond, Va.; Louis F. Warrick, State Board of Health, Madison, Wis.

Division of the History of Chemistry: Chairman, Tenney L. Davis, of the Massachusetts Institute of Technology; *secretary,* Mildred W. Grafflin, of the Hercules Experiment Station, Wilmington, Del.; *on executive committee,* Charles A. Browne, of the U. S. Bureau of Chemistry and Soils, Washington, D. C.; Frank B. Dains, of the University of Kansas; Claude K. Deischer, of the University of Pennsylvania.

Division of Chemical Education: Chairman, Martin V. McGill, of Lorain High School, Lorain, Ohio; *vice-chairman,* Stuart R. Brinkley, of Yale University; *secretary,* Norris W. Rakestraw, of Brown University; *treasurer,* Virginia Bartow, of the University of Illinois; *on executive committee,* B. C. Hendricks, of the University of Nebraska; W. T. Read, of Rutgers University; Otto Reinmuth, of the University of Chicago; O. M. Smith, of Oklahoma Agricultural and Mechanical College.

The group of divisional officers elected Professor George Scatchard, of the Massachusetts Institute of

Technology, as chairman, and Professor Norris W. Rakestraw, of Brown University, as secretary.

Professors John E. Ricci, of New York University; Vincent du Vigneaud, of Cornell University Medical School, and H. B. Vickery, of the Connecticut Agricultural Experiment Station, were elected to five-year terms as associate editors of the *Journal of the American Chemical Society,* while Professor Linus C. Pauling, of the California Institute of Technology, and Dr. George S. Whitby, of the National Research Council, Ottawa, Canada, were reelected as associate editors. Professor Moses Gomberg, of the University of Michigan, was chosen to fill the vacancy caused by the death of Elmer P. Kohler.

Three reelected as associate editors of *Technological Monographs* were: Dr. Walter A. Schmidt, president of the Western Precipitation Company, Los Angeles; Dr. Edward R. Weidlein, director of the Mellon Institute of Industrial Research, Pittsburgh; Fred C. Zeisberg, of E. I. du Pont de Nemours and Company.

W. A. Noyes, Jr., professor in the University of Rochester, becomes editor-in-chief of *Chemical Reviews* on January 1, succeeding Dr. Gerald L. Wendt, of New York City. Named associate editors were: W. S. Calcott, of the du Pont Company; Professor Wendell M. Latimer, of the University of California; Professor W. Conrad Fernelius, of Ohio State University.

New associate editors of the *Journal of Physical Chemistry* are Professor George S. Parks, of Stanford University, and Professor George Glockler, of the University of Minnesota.

Dr. Beverly L. Clarke, of the Bell Telephone Laboratories, New York City, and Thomas R. Cunningham, of the Union Carbide and Carbon Research Laboratories, Niagara Falls, N. Y., were reelected associate editors of the Analytical Edition of *Industrial and Engineering Chemistry.*

Dr. Walter A. Schmidt, of Los Angeles, was named again to the society's Council Committee on Policy for three years.

SPECIAL ARTICLES

HOST-PARASITE INTERACTIONS WITH BACTERIAL WILT OF MAIZE[1]

IT is commonly believed that bacterial virulence in disease is maintained or enhanced by host passage The constitution of the host is considered to play little part in the ultimate virulence attained. In conformity with Wellhausen's[2] recent studies I propose to show by another technique that such is not always the case.

Virulent strains of *Bacterium stewartii* (E.F.S.) Stevens, (*Phytomonas stewartii* (E.F.S.) Bergey, *et al.*), a vascular, bacterial wilt disease of maize, are characterized by colonies that are large, smooth, spreading and of a mucoid type; avirulent strains are smaller, slightly rough, raised and of a non-mucoid type. Each strain arising from single-cell isolations is constant for colony type and virulence, so that morphological characters may be used to separate individuals with different physiological potentialities.

Mixtures of virulent and avirulent bacteria of varying but known proportions were inoculated into resistant and susceptible inbred lines of maize by injecting the organisms into the growing points of seven-day-old maize seedlings with a hypodermic syringe and needle. The subsequent proportions of virulent to avirulent types may be followed by isolating at suitable intervals of time from the host. For each isolation, lesions from 10 or more plants were macerated together in a small quantity of sterile water and dilution plates poured from this liquid. In order that colony morphology could be classified, only surface smeared plates were used. In six experiments isolations were made each 4 days after inoculation; in seven other experiments isolations were made only at the end of the experiment. Total passage time varied from 14 to 20 days.

There is a correlation of $r = 0.95 \pm 0.02$ between the ratio of virulent and avirulent bacteria in the inoculating suspension and the ratio obtained by isolating from the first definite lesion. This shows that the bacteria which actually grow and produce a diseased condition are reliably estimated by plating directly from the inoculating medium.

Upon passage through the susceptible host there is a differential selection for the avirulent type of bacteria. For example, beginning with a 50–50 proportion of virulent to avirulent bacteria, the proportion observed after a 15-day passage averaged 39–61. The rate of this change during host passage is dependent upon the initial proportion of virulent to avirulent bacteria in the inoculating medium. The rate of change is slow in a population containing a high proportion of avirulent organisms. When these rates of change are plotted against the initial proportion of avirulent bacteria in the inoculating medium, the slope or regression of these rates is linear and equal to -1.1 (Fig. 1—line A).

Passage through the resistant host results in a differential selection for the virulent type of bacteria, instead

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[1] Journal Paper No. J-596 of the Iowa Agricultural Experiment Station, Genetics Section, Project 404.

[2] E. J. Wellhausen, *Phytopath.*, 27: 1070–1089, 1937.

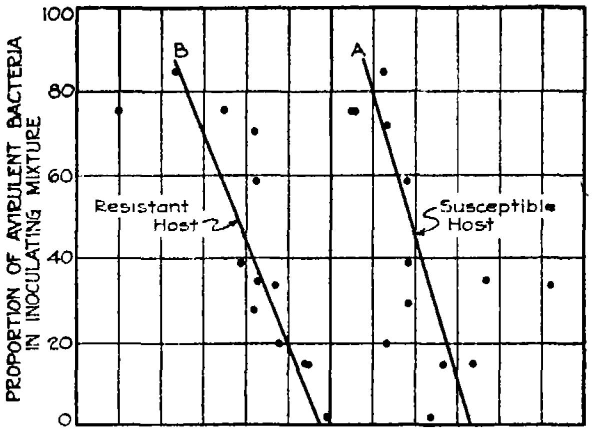

FIG. 1. *Rates of change of proportion of avirulent and* virulent bacteria when passed through resistant and susceptible hosts. On passage through the susceptible host the change toward a higher proportion of avirulent types is slow in a bacterial mixture composed largely of avirulent types (line A)—*passed through the resistant host* the change toward a lower proportion of avirulent types is rapid (line B).

of the avirulent as in the experiment above. When the *initial proportion of virulent to avirulent bacteria* was 50–50, the proportion observed after a 15-day passage averaged 63–37. The inoculum containing a high proportion of virulent organisms changes at a slow rate toward the limit of 100 per cent. virulent organisms. The inoculum containing a low proportion of virulent organism changes rapidly toward one of higher proportions. Again, plotting these rates of change during passage against the initial proportion of avirulent bacteria in the inoculating medium, the slope of these ratios is linear and equal to − 1.7 (Fig. 1—line B).

Changes in the proportions of the virulent and avirulent types of bacteria proceed in orderly fashion from the time of inoculation to the death of the host, the direction of the change depending on the host.

Virulent bacteria kill the susceptible host in from 10 to 15 days, but only stunt the resistant host. Avirulent bacteria stunt but do not kill the susceptible host and become limited to the first early lesions in the resistant host. Assuming, as a working hypothesis, that the most advantageous host-parasite relation is one of equilibrium with a virulence sufficient to overcome host resistance, yet not so virulent as to kill the host, then selection within the micro-environment of the host over long periods of time would be towards such equilibrium. This point is approached in the low degree of virulence of bacteria adapted to the susceptible host and in the high degree of virulence in resistant maize.

With the materials used in these experiments, the rate of change in the bacterial population proceeded more rapidly within the resistant host than within the susceptible host as shown by the slope of the general regression lines (Fig. 1). The rate of change in the population is not a constant, but changes as the population changes, being rapid when equilibrium is greatly disturbed, weakening as equilibrium is approached.

The conclusion that intensity and direction of selection are dependent upon host resistance has been verified through using 14 other inbred lines of maize as host.

RALPH E. LINCOLN

IOWA STATE COLLEGE

A SIMPLE TECHNIQUE FOR CONTROLLING SUBJECTIVE ATTITUDES IN SALIVARY CONDITIONING OF ADULT HUMAN SUBJECTS

IN the last six years the writer has been engaged in a series of experiments on salivary conditioning in adult human subjects. The method used for measuring the saliva consisted of weighing increments in dental cotton rolls (Johnson and Johnson, No. 3, 0.5 × 1.5 in.) inserted under the subjects' tongues for short periods of time, usually one minute. Since the cotton-in-the-mouth was by no means a totally inactive stimulus, periods of control salivation had to be temporally rotated with experimental periods, and, again, to prevent evaporation, scale-corrosion and absorption, the rolls had to be weighed in small envelopes and reweighed in the envelopes immediately after the removal of the rolls from the subjects' mouths. The method of measuring by itself proved to be quite satisfactory and reliable—the magnitudes of the S.D.'s of the salivations in 20 to 30 trials under uniform conditions being seldom greater than one eighth of the magnitudes of the means—but the conditioning was irregular and rather unsuccessful, despite the fact that the writer followed closely the general methodology of Russian investigators with animals.[1, 2] A statistical analysis of the data and an introspective check clearly revealed that the disturbing factors in the writer's[3, 4, 5] conditioning experiments were the subjects' sets and attitudes, their "catching on" after a few trials to "what is expected" or "what is not expected" of them. These attitudes

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[1] I. P. Pavlov, "Conditioned Reflexes." Oxford University Press, 1927. Pp. xv + 430.

[2] N. A. Podkopaev, "The Methodology of Investigating Conditioned Reflexes." Moscow: GIZ, 1926. Pp. 64.

[3] G. H. S. Razran, *Arch. Psychol.*, 28: 191, 124, 1935.

[4] G. H. S. Razran, *Jour. Psychol.*, 2: 327–337, 1936.

[5] G. H. S. Razran, Studies in configural conditioning. I. Historical and preliminary experimentation. (In press, *Jour. Gen. Psychol.*) II. The effects of task-sets and subjects attitudes upon configural conditioning, *Jour. Exp. Psychol.*, 24: 95–105, 1939. III. The factors of similarity,

produced irregularity and sporadicity in the acquisition of the salivary conditioning, interfered with its progressive extinction in non-reinforced trials, and in general masked a number of otherwise established conditioning attributes. While attitudes as variables are in themselves of considerable interest and while it may very well be that "conditioning with attitudes" parallels human life-situations, it still is, of course, apparent that they must be ruled out when the properties of conditioning *as such* are to be studied.

In the last three years the writer has, therefore, used a method which is comparatively free from this incubus of subjective interferences. The method may be called the "seriate-continuous-and-misinform" technique. It consists of presenting a *series* of conditioned stimuli rather than a single stimulus during comparatively long continuous eating periods and misinforming the subjects about the purpose of the experiment. Thus, in one study the eating periods—small pretzels, tea-sandwiches, lollipops or chewing gum—were of 2-minute duration, in the course of which 40 intermittent flashes of colored lights were presented. The subjects were told that the purpose of the experiment was to "find out the effect of eye-fatigue upon digestion." In another investigation in which musical chords were the stimuli-to-be-conditioned the eating period lasted for 4 minutes and the influence of music on digestion was offered as the experimenter's real objective. In a third experiment with nonsense syllables a pure conditioned salivation set-up was disguised as a seemingly *bona fide* memory problem, while in a fourth study eating and conditioning were successfully combined with hypothetical solutions of electrical mazes. Thirty-six subjects were used in these experiments and 5 to 10 experimental sessions of 1 to 3 hours' duration were made with each subject. However, so far not a single subject has shown any evidence of any *conscious* associative set between the feedings and the stimuli given during their action in the sense that he thought that he was *expected* to secrete or not to secrete saliva when the stimuli were on; the conscious task-set was merely directed elsewhere—digestion, memorization, maze solution—and was non-functional for the particular association. At any rate, the conditionings were in all these cases highly successful and strikingly conforming with Pavlov's main behavioral findings in acquistion, extinction, spontaneous recovery, generalization, differentiation, and the like.

G. H. S. Razran

Columbia University

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proximity and continuity in configural conditioning. (In press, *Jour. Exp. Psychol.*) IV. Gestalt organization and configural conditioning, *Jour. Psychol.*, 7: 3–16, 1939. V. Generalization and transposition. (In press. *Jour. Genet. Psychol.*) VI. Comparative extinction and forgetting of pattern and single stimulus conditioning. (In press, *Jour. Exp. Psychol.*)

THE CULTIVATION OF TRITRICHOMONAS FOETUS IN DEVELOPING CHICKEN EGGS

Recently a considerable number of viruses have been propagated in developing chicken embryos and in their extra-embryonic membranes; Zia (1934)[1] has reported similar cultivation of a *Rickettsia*; and the chorio-allantoic membrane of avian eggs is a favorite position for tissue grafts in experimental embryology. However, there is apparently no record of protozoa ever having been cultivated in developing eggs. The investigation here reported was designed to ascertain the possibility of propagating certain protozoa in this environment.

The strain of *Tritrichomonas foetus* which was used was obtained in bacteria-free culture on Ringer's-egg-serum medium[2] by one of us (N. D. L.) from a case of bovine abortion in an Illinois herd of dairy cattle. The eggs were obtained from a breeding flock of White Rock chickens free from infectious diseases.

Eggs which after incubation for periods of 8 to 16 days showed strong vigorous embryos were used. Then the technique described by Brandly[3] for propagation of laryngotracheitis virus was employed with the necessary modification of introducing the inoculum into the allantoic sac instead of upon or within the chorio-allantoic membrane. Following inoculation, the opening is closed with Cellophane or cellulose tape and the eggs are returned to the incubator.

In examining the eggs, the shell over the air-sac and the shell membranes are removed aseptically, and some allantoic fluid drawn off with a sterile pipette and examined under a microscope. Trichomonads may not be demonstrated in all eggs inoculated with suitable cultures. Unsatisfactory introduction of inoculum is considered to account only in part for this variation. Furthermore, trichomonads, when present, may vary in numbers from less than one to several hundred per field under the 16 mm objective. Usually, transfers were made only from those eggs in which the trichomonads were abundant.

There is no doubt that the protozoa actually multiply in the eggs, rather than merely survive. Twenty-two serial transfers from egg to egg of bacteria-free protozoa have been made over a period of about three months, with a multiplication factor of about 30 at each transfer. The eggs are opened and examined two or three days after inoculation, as much allantoic fluid as possible being saved in sterile test-tubes. Five or more cc may be obtained from one egg, although usually about 2 cc are readily recoverable. If bacteriologically sterile, the fluid is used for the inoculation of another series of eggs. The trichomonads will survive in allantoic fluid placed in cotton-plugged test-tubes for several days at room temperatures, but in the egg, death of the embryo may be followed very shortly by mortality of the protozoa.

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[1] S. Zia, *Am. Jour. Path.*, 10: 211, 1934.

[2] C. W. Rees, *Am. Jour. Hyg.*, 26: 283, 1937.

[3] C. A. Brandly, *Jour. Infect. Diseases*, 57: 201, 1935.

No pathogenic action by these protozoa on the chick embryo has ever been noted. If left in the incubator for the full incubation period, normal chicks hatch out. Trichomonads are no longer present, since the allantoic fluid has disappeared.

It is apparently not necessary for the trichomonads to be entirely free of bacteria in order to multiply in the allantoic fluid, since the presence of saprophytic air-contaminants has been found not to prevent their development. If, however, the bacteria kill the chick embryo, the trichomonads die in a day or two.

Preliminary series of experiments indicate that eggs which have been incubated about 12 days are more satisfactory for cultivation of *Tritrichomonas foetus* than eggs incubated for shorter or longer periods. An incubation temperature of 37° C. is better than 34.5° C. or 39° C.

Tritrichomonas muris from the rat has also been cultivated in developing eggs, but no sub-cultures have been attempted to date.

Since protozoa have already been cultivated in artificial culture media and in tissue culture, the use of developing chicken eggs offers a third type of medium which may prove of value in experimental propagation studies.

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THE PRODUCTION OF GOITER IN CHICKENS[1]

ALTHOUGH goiter in poultry has been noted in iodine-deficient areas,[2] no report of its experimental production has been found. We have obtained goiter in chickens with a ration containing .145 mg per kilo of iodine, and have prevented goiter by the addition of 5 mg per kilo of iodine to the same ration.

Five hundred White Leghorn chicks were used in the two lots. The basal ration contained 71.5 per cent. yellow corn meal, 25 per cent. soybean oil meal, 1 per cent. casein, 0.5 per cent. salt, 2 per cent. bone ash, 0.001 per cent. activated animal provitamin (50,000 units of D per gram), 0.015 per cent. manganous sulfate, and 0.03 per cent. of a salt mixture. The vitamin G requirements for growth were supplied by liquid skim milk.[3]

Thyroid weights of chickens fed the basal ration were 130 per cent. of the control thyroid weights at 6 weeks, 240 per cent. at 12 weeks and 294 per cent. at 18 weeks. In extreme cases, thyroids have been found to approximate twenty times normal weight.

Histopathological examinations of the enlarged thyroids at these intervals during growth showed an absence of colloid and a hyperplasia of the living cells of the follicles. These changes were apparent at 6 weeks and increased in severity with age. Thyroid glands from the control group remained normal.

Work on the iodine requirements of poultry is being continued.

A. R. PATTON
H. S. WILGUS, JR.
G. S. HARSHFIELD
COLORADO AGRICULTURAL EXPERIMENT STATION,
FORT COLLINS, COLORADO.

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* Assigned by the State Department of Agriculture to assist in diagnostic and research work.

[1] This work is being conducted through an investigatorship established by the Iodine Educational Bureau, Inc., New York. The Vitamin D solution was generously supplied by Dr. J. J. Waddell, Biological Laboratory, E. I. du Pont de Nemours and Company, Wilmington, Delaware.

[2] H. Welch, *Montana Agr. Exp. Station Bulletin*, 214, 1928.

[3] G. F. Heuser, H. S. Wilgus, Jr., and L. C. Norris. *Poultry Science*, 11: 105, 1938.

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British Guiana Papers; Scientific Results of the Oxford University Expedition to British Guiana in 1929. Illustrated. Oxford University Press. $7.00.

DEAVER, GEORGE G. *Fundamentals of Physical Examination.* Pp. 299. 126 figures. Saunders. $2.75.

HECTOR, J. M. *Introduction to the Botany of Field Crops; Vol. I—Cereals.* South African Agricultural Series. Pp. xi + 478 + xxxiv. 190 figures. Central News Agency, Johannesburg. £3.10.0 per set.

HOOTON, EARNEST A. *Crime and the Man.* Pp. xvi + 403. Illustrated. Harvard University Press. $3.75.

MACDERMOT, H. E. *Sir Thomas Roddick; His Work in Medicine and Public Life.* Pp. xiii + 160. Illustrated. Macmillan. $2.00.

MUENSCHER, WALTER C. *Poisonous Plants of the United States.* Pp. xvii + 266. 75 figures. Macmillan. $3.50.

MUDGE, COURTLAND S. and FLOYD R. SMITH. *A Fundamental Approach to Bacteriology.* Pp. vii + 265. 17 figures. J. W. Stacey, San Francisco.

NEYMAN, J. and E. S. PEARSON, Editors. *Statistical Research Memoirs, Vol. II, December, 1938.* Pp. 149. Illustrated. Department of Statistics, University College, London. 15 s.

Papers in Physical Oceanography and Meteorology, Vol. VII, No. 1; Fluid Mechanics Applied to the Study of Atmospheric Circulations, Part I, December, 1938. Pp. 125. 24 plates. Massachusetts Institute of Technology and Woods Hole Oceanographic Institution. $1.50.

Research—A National Resource; I, Relation of the Federal Government to Research; Report of the Science Committee to the National Resources Committee, November, 1938. Pp. vii + 255. Superintendent of Documents, Washington. $0.50.

SINNOTT, EDMUND and L. C. DUNN. *Principles of Genetics.* Third edition. Pp. xiv + 408. 147 figures. McGraw-Hill. $3.50.

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SCIENCE, RELIGION AND SOCIAL ETHICS[1]

By Sir RICHARD GREGORY, BART.

RETIRING EDITOR OF NATURE

MANY reasons have been put forward to account for the origin of religion, but it can not be said that any of them have solved the problem. Ancestor worship, ghost propitiation, worship of the soul, belief in spiritual beings, reverence for tribal leaders, have all been suggested as originating causes of religious sentiment. Primitive man had no religion except such as was embodied in a system of social virtues. Men possessing these virtues to a high degree, and using them to make the tribe powerful or conditions of life more pleasant, would be esteemed as benefactors or heroes not only during life but after death, and this veneration would develop into ancestor worship and later into soul worship.

If it is assumed that the divine purpose of the existence and evolution of life upon the earth is that man should work out his own salvation, it is difficult to understand what the ultimate gain will be when the earth will no longer be in a condition to maintain life as we conceive of it. All that science can say as to the future of the earth, or of any other planet or system in the astronomical universe, is expressed in the words of the hymn, "Our little systems have their day: they have their day and cease to be." We may contemplate the progressive development of man and society to any stage that may satisfy our ideals, but, so far as we
know, the whole phantasmagoria will
dissolved, and the death of mankin
penalty for achieving the high
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[1] Concluding part of the fifth Elihu Root Lecture of the Carnegie Institution of Washington, given on December 8, 1938. The substance was included in a lecture before a general session of the American Association for the Advancement of Science, Richmond, Virginia, December 29, 1938.

individual should neglect noble motive and conduct because he himself has to pass away whether his influence has been for good or evil. Though science is unable to provide any positive evidence for survival of personality after death, it must acknowledge that belief in such survival is a powerful ethical factor in human development. It is just as permissible, therefore, to assume that another world awaits habitation by an exalted type of humanity after this earth has come to an end, as it is to believe in the eternal existence of individuality.

Whatever convictions may be held as to the future of man or humanity, the standard of goodness is decided by the community. The man who lives a moral life merely because he wishes to save his own soul is little better than an expectant hedonist; for his motive is personal profit. He may be saved from punishment hereafter by being negatively evil, but his life will be of no benefit to the human race unless he is positively good. What existence awaits us when we are called away we can not say, but we find stimulus and high endeavor in the hope that each thread of life is intended to contribute to the web designed by its Creator. Though science may not be able to contribute much to the ultimate problems of spiritual beliefs, it does teach that every action carries with it a consequence—not in another world, but in this—to be felt either by ourselves or by others in our own time or the generations to come.

Evidence of the progressive development of forms of life in the past and of changes still going on is so convincing that it may almost be regarded as a law of nature. In so far, therefore, as evolution signifies an orderly succession of organic growth, few would venture to deny the fact; but how and why such changes are brought about has not yet been established beyond discussion. Whether organic evolution has proceeded by gradual development of small variations of structure and habits, or by the sudden appearance of new forms, is a question for naturalists to decide among themselves in their search for natural causes. The court of observational science is concerned only with evidence which throws light upon such causes, without assuming the existence of supernatural design or intervention. Whether behind the natural causes producing evolution there is a transcendental principle or architect is not the concern of naturalists but of other philosophers. Their position is that even if the facts of organic evolution can not be explained by existing
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ses *and* consequences, without intro-
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bjective evidence.

e when, in order to afford
d the Mosaic account of creation in particular, it was only necessary to find naturalistic or rationalistic explanations of miraculous and other elements in biblical records. Such attempts to fit all new knowledge into a system of thought having no claims to scientific accuracy or intention served no useful purpose to the Bible or to science, and to-day would satisfy neither historical students nor naturalists. A much sounder basis can be found by applying evolutionary principles to religious thought and by studying sacred books as stages in the story of man's progressive discovery in theology. It is only by disregarding history that the idea of a fixed and final theology becomes possible. In science, there are no final interpretations or unchangeable hypotheses; and if the same principle were recognized in theology, religion would share some of the vitality of the natural sciences. Evolution can be regarded by the theologian as merely the means of creation; and the conception of gradual development is not incompatible with Christian theology. It is through the acceptance of the idea of evolution in the spirit as well as in the body of man that the partition which formerly separated religion and science is being dissolved.

In recent years, there has been much discussion of the ethical or social consequences of the application of mechanical and other scientific discoveries to industry. In the early days of the industrial revolution in England, there was little of the scientific spirit in industry. The discoveries of science were used with as much indifference to science as to humanity. The inventions of the eighteenth and early nineteenth centuries came from the workshop rather than from the scientific laboratory. Machines were devised and operations developed largely by trial and error methods, and academic research had few points of contact with industrial practice. The characteristic of the present age is the utilization in industry of principles, properties and products revealed by scientific research, whether carried on solely in the pursuit of knowledge or with a practical purpose in mind.

It is sometimes suggested that progressive science and invention are responsible for the troubled condition of the world at the present time, owing largely to overproduction. It would be just as reasonable to blame the Almighty for good harvests, or for providing in some parts of the world all the means of existence for primitive man without the need for labor. The fault is not with those who create gifts for men's comfort and enjoyment, but with the social system which prevents their easy distribution and use. A century ago, most of the machines and engineering works which now make up a large part of our industrial life, and which are supposed to have led to unemployment, did not exist, yet there was then wide-spread unemployment and poverty. The population of Great Britain was then only sixteen millions, yet there were two millions in workhouses or receiving outdoor relief. The terrible conditions of those days were bitterly described by Carlyle in "Past and Present." He wrote:

> We have more riches than any Nation ever had before; we have less good of them than any Nation ever had before. Our successful industry is hitherto unsuccessful; a strange success if we stop here! In the midst of plethoric plenty, the people perish; with gold walls and full barns no man feels safe or satisfied. Workers, master workers, underworkers, all men, come to pause; stand fixed, and cannot go farther.

In the "hungry forties" the mechanization of transport and industry was but in its early stages, and if the description of Carlyle is a correct one it is apparent that there is little justification for trying to lay the blame for the unemployment of to-day at the feet of the mechanical inventors. When Carlyle wrote, men still traveled by stagecoach and sailing ships, and a multitude of things were done by manual labor which to-day are done by machinery. When first introduced, new machines, it is true, do tend to displace labor in one direction, only, however, to stimulate it in another, and in the end greater wealth is created. The problem to-day, as it was a century ago, is to adapt the social and economic systems to the new conditions brought about by advances of science and invention. For a people to be made wretched in proportion to the increase of means of producing plenty shows that there is something radically wrong in industrial or social economics.

It is of course natural that labor, with its memory of bitter struggles against long hours and low wages, should stress much more acutely the problem of distribution of the products of its toil than that of the factors of industrial progress. The artisan has had good reason for regarding every labor-saving device as a wage-saving device; and it is almost a mockery to suggest to men who find themselves unwanted through the introduction of particular machinery that the ultimate effect will be increased employment. The thought, however sound it may be in industrial economics, affords poor satisfaction for present needs. Men thus displaced through no fault of their own may rightly claim, on the ground of humanity alone, that the community which is eventually to benefit by the saving in costs of production should accept a measure of responsibility for the maintenance of those whose means of existence are suddenly taken from them.

In the history of early civilizations, a condition of stagnation and of internal dissention has usually preceded their decline and extinction. The end has come through conquest by military forces of a superior type or by the invasion of hordes of barbarians whose only motive was plunder. It used to be suggested that modern civilization would be saved from this fate by the powers with which science has provided civilized peoples to protect themselves against overwhelming numbers having only primitive weapons. Few people thought that the yellow and dark races would ever be able to dispute the supremacy of the white races, even though equipped with modern weapons, but that view could scarcely be held to-day. The perils which threaten modern civilization are not, however, so much from the greater numbers of peoples who may eventually possess powerful appliances of war as from the very peoples who have themselves perfected such weapons. Efficient barbarity made no distinction in the Great War between the destruction of masterpieces of architecture and ammunition dumps; and, since then, aerial bombing of any center of life or of beauty seems to be accepted as a means of offensive action by nations which claim to be civilized. Instead of science having to save modern civilization from being overwhelmed by barbarous hordes, it seems to have provided the means of self-destruction. Man has advanced so little in spiritual evolution that he is just as much a barbarian in his use of aerial bombs and poison gas as he was when his weapons were only clubs and arrows.

Such prostitution of the rich gifts with which modern science has endowed the human race must be condemned by all who see, in the general feelings of civilized people to-day, incipient stages in the development of characteristics which distinguish man from other living creatures. The law of the jungle is that of the battle to the strong, and the race to the swift. It recognizes no right to live except by might; destroys the weak; has no sympathy with suffering, and no sense of the highest human values. In the struggle for existence, man has survived because his physical structure and intelligence have enabled him, individually and in communities, to master the things which would destroy him. His social instincts have at the same time been extended from the family to the tribe, the nation and the empire, and will reach their highest and best when they embrace the world.

The virtues which should be prized most to-day, if civilization is to mean the evolution of social ethics to a noble plane, are regard for spiritual values, love of truth and beauty, righteousness, care for the suffering, sympathy with the oppressed and belief in the brotherhood of man. These are the principles of the Sermon on the Mount; and they must be accepted by all who believe in progressive human development. And nation or people which separates itself from the rest of the world in the name of race or religion, and cultivates ideals of conquest by force in order to assert its claims, is not assisting human evolution but retarding it.

Science has made the world one through the facilities of communications and transport now available; and it recognizes no political or racial boundaries in its fields of knowledge. Among modern social and intellectual forces, science alone speaks in a tongue which meets with universal understanding. The conception of science as a social factor intimately linked up with human history and human destiny gives a new meaning not only to scientific research but also to the position of citizens who are engaged in it.

Both rightly and wrongly, science has been blamed for much of the wastage of life which has been brought about by the rapid applications of scientific knowledge to purposes of peace and of war. Men of science are, however, citizens as well as scientific workers; and they are beginning to realize their special responsibilities for making sure that the fruits of scientific knowledge are used for human welfare. They can no longer remain indifferent to the social consequences of discovery and invention, or be silent while they are blamed for increasing powers of production of food supplies, providing means of superseding manual labor by machines and discovering substances which can be used for destructive purposes. It would be a betrayal of the scientific movement if scientific workers failed to play an active part in solving the social problems which their contributions to natural knowledge have created.

The view that the sole function of science is the discovery and study of natural facts and principles without regard to the social implications of the knowledge gained can no longer be maintained. It is being widely realized that science can not be divorced from ethics or rightly absolve itself from human responsibilities in the application of its discoveries to destructive purposes in war or economic disturbances in times of peace. Men of science can no longer stand aside from the social and political questions involved in the structure which has been built up from the materials provided by them, and which their discoveries may be used to destroy. It is their duty to assist in the establishment of a rational and harmonious social order out of the welter of human conflict into which the world has been thrown through the release of uncontrolled sources of industrial production and of lethal weapons.

Science can only continue to render its fullest service to the community as the relations between the general scientific worker and the general citizen are harmonized and the purposes and methods of science are widely understood. In the establishment of such a sympathy, a nobler type of citizenship becomes possible, adequate to defend us against the dangers to which civilization is exposed and to build a social order worthy of the limitless powers which the advance of science has placed in the hands of man. It is in the light of service to these high ideals that science, without which we can not live, and religion, without which most people see no meaning in life, can find a field in which both can work together for the highest human destiny.

CONCERNING ECOLOGICAL PRINCIPLES[1]

By Professor W. C. ALLEE and Dr. THOMAS PARK
UNIVERSITY OF CHICAGO

THE statement is frequently made that ecology deals mainly with facts which are organized around relatively few principles. Usually this is given as a reproach by non-ecologists, sometimes if not with pride, at least with resignation, by ecologists. If such a condition exists, it seems to us to be a cause for regret. For a number of years we have been interested in thinking over this problem and in collecting distinctly ecological principles from the literature as well as in amassing evidence dealing with more specific problems. The present paper is presented as a report of progress in the hope of provoking discussion which may make future ecological work more effective.

In making this study we are not conscious of having contributed anything new, even though we find the results at least mildly stimulating. It is not our concern at present to deal with the history, with the personalities associated with the different principles or with the date of their discovery. This means that we are not particularly interested in the percentage of these principles which have grown out of modern, self-conscious ecology. Our only care has been to select and make some preliminary attempts at classification of those principles that deal in the main with interrelations between an organism, or one or more groups of organisms, and its or their environment.

It would be relatively easy to become entangled in a discussion of terminology in connection with the consideration of ecological principles. We wish to avoid this as far as possible and shall at times use only one of a number of common terms associated with a given idea. Our selection in such cases will be based on our personal usage rather than on a fully reasoned consideration of the merits of possible alternative terms. Our whole emphasis for the moment is on ecological ideas which we think have merit, rather than on terminology or even on the evidence that supports these generalizations.

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[1] We are indebted to Alfred E. Emerson and to Karl P. Schmidt for reading a preliminary draft of this manuscript and for making pertinent suggestions.

With this general introduction, it is desirable to give a few orienting definitions and ideas. A principle is a fundamental truth or a proposition which can form the basis of reasoning. It represents a synthesis of data and concepts which have been gained by analysis. A living organism, as well as we can define it, is a physicochemical mechanism in dynamic equilibrium which displays the self-regulating, self-perpetuating qualities which in the aggregate we call life; or it is such a mechanism plus some powers and forces unknown to modern physics and chemistry, which may or may not be within the range of human knowledge. The environment of any organism consists of everything in the universe external to the cells and intimately utilized cell products of that particular organism. No part of this environment is without potential effect on any organism, although some phases have such a direct importance that they are regarded as comprising the effective environment. The distinction between the effective and the non-effective environment is one of degree of influence rather than of kind. The relation between any living organism and its environment is, in the language of Professor Pearl,[2] (1) particular, (2) continuous, (3) reciprocal and (4) indissoluble. Since we are considering the organism as a unit, we do not need to discuss matters concerned with the intra-organismal environment.

It is not advisable in the present state of our knowledge to dwell upon a general scheme of classification of ecological generalizations. We feel, however, that such a scheme can be worked out and that by making certain assumptions, ecological concepts and principles may be grouped at least as logically as the phenomena on which they are based.

Some of the possible subdivisions are (a) into these generalizations which are primarily quantitative as contrasted with those which, as far as we now can see, are qualitative only. The former may be illustrated by what we know concerning the growth of experimental populations. On the other hand, our information about protective coloration, for example, is as yet primarily qualitative. From a different point of view (b) principles can also be divided into the relatively few in which causal relations are known, as contrasted with the many for which the underlying causes are still obscure. The rough classification we shall follow is mainly one of convenience and is based on fairly obvious primary relationships.

There is a whole series of principles concerned more primarily with the environment than with the organism and another series in which the point of view is reversed. To the working ecologist the environment is holocoenotic, that is, it is a unit composed of many parts, as a rope is made of many strands. Even though holocoenotic, the different parts may at times assume control as the concentration of one of them approaches the minimum or maximum which the animal can tolerate and hence acts as a limiting factor. Here we have the well-known "law" of the minimum and the less emphasized "law" of the maximum. Here also arises the concept of an ecological optimum and with its opposite, an ecological pessimum. The degree of fitness which organisms and environment exhibit may be thought of as ecological valence or öky. From this we move on the one hand to the general idea of euröky and stenöky, which may be broken down into wide or narrow toleration for the different elements in the environment. On the other hand, there is the concept of vagility which is concerned with the powers of dispersal of a given species, or by extension, of a given community. This capacity for active dispersal or passive transport is an important factor in determining geographic range.

There are many rules that have been worked out concerning the effect of environmental factors on organisms; for example, the Arrhenius, Van't Hoff and Krogh temperature equations, the matter of temperature summation and its corollary, the life zone concept, which is closely related to the so-called bioclimatic law. In this general category belong also the different principles concerning the effect of light on organisms, such as the Bunsen-Roscoe "law" which states that the effect of light is, within limits, a function of intensity multiplied by duration of its action; the rule that only absorbed light is effective and that the percentage of incident light which is absorbed is independent of the amount present; and many more. There are also the various applicable laws concerning vapor pressure of water, of hydrostatics and of similarly fundamental principles of meteorology, geology, physics and chemistry which concern the fitness of the environment to support life. In many of these physical relations we must recognize short, intermediate and long-time periodicities as well as important elements of stability in the environmental complex. Phenomena associated with migration and emigration are related to certain of these environmental periodicities.

In shifting our attention so as to consider organisms more directly, we come immediately upon adaptation, which is, of course, correlated with ecological valence. The latter is a term sometimes used by ecologists to express the mutual requirements of environment and organism. Various attempts to organize ecology about types of specific adaptation have failed, but the fact remains that an organism must have a somewhat larger number of positive than of negative adaptations to its environment if it is to persist. This, we submit, is a fundamental principle for biology in general as well as for ecology; it must hold for the biotic community as a unit as well as for the individual or the species.

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[2] Unpublished lecture.

Certain environmental adjustments are apparently adaptive, for example, Bergmann's rule that related warm-blooded animals tend to be smaller as one approaches the tropics and the related rule of Allen that the appendages of such animals tend to be smaller the colder the climate. The rule of Gloger, that animals in warm humid regions tend to be more melanic than those in arid or in cool climates, is not so obviously adaptive In this respect there is resemblance to Jordan's rule of the relation between numbers of vertebrae of fishes and temperature. The general principle of environmental induction that finds a striking demonstration in the determination of the fundamental organization by environmental action on the eggs of *Fucus* is more plainly adaptive, as is the widespread principle of convergence and of generalized mimicry which, in fact, may be merely a special instance of convergence.

The community concept is frequently thought of as being the only major ecological principle, an idea with which we do not agree. The self-evident individuality of animals makes equally self-evident the fact that individual animals have environmental relations with their physical environment as well as being immersed in a biotic community; hence the community, while important, is not all-important in ecology. All animals live in communities which include plants as well as other animals. These biotic communities range from those primarily integrated by environmental action, the so-called *ecofaunae* of Uvarov and ecoflorae, through the less closely knit biocoenoses to the truly social groups. Within all sorts of communities, animal aggregations may exist as more or less dense, more or less temporary collections of the same or of different species.

From the fact that animals live in communities it follows, even without the recent laboratory analyses of increased survival values that are frequently shown by aggregated animals, that there must be certain cooperative relations between organisms. This does not refute the obvious point that organisms also interact with each other to their disadvantage as well as to their advantage. The word cooperation has picked up certain engrafted meanings; basically it signifies working together and in this sense, as unconscious cooperation or automatic mutualism, it is one of the important integrating forces in community life. Much of the significance of this fact has long been recognized in the literature concerned with symbiosis in its various degrees from commensalism through mutualism and the truly social phenomena.

The gregarious habit also gives rise to generalizations which may be basically biotic or may grow out of relations with the physical environment. Thus there is a tendency for the animals at the base of food-pyramids to be gregarious and for the predators at their apices to be solitary. Also the larger animals in monotonous physical habitats tend to be more gregarious than are similar forms in strongly dissected habitats.

Communities have internal, spacial and temporal organization. Within the community there are various degrees of influence, which range from marked dominance to incidental or accidental forms. The organization in time introduces ecological succession or community evolution, which proceeds as a result of both biotic and of physical causes and which is essentially predictable. There is also the process of maturation of the community without evolution during which the pioneer forms develop to a mature stage of the community in question without ecological succession taking place. Community evolution tends towards a climax. This may be local, or as a biotic formation may be geographic in extent and composed of similar but slightly different associations or other less important units which are determined primarily by the dominant organisms but which may be recognized at times by differences in other influential constituents.

Communities are organized about the web-of-life relationships which include such factors as the utilization of environmental niches. In this connection, particularly with the vertebrates, there is a whole set of principles connected with territory, migration and with breeding, shelter and feeding ranges. These include such ideas as those connected with habitat "selection," as for example Hopkins' host selection principle and the concept of a "forced selection of habitat." The web-of-life is also concerned with food chain, food web and food pyramid relationships.

A quantitative approach to communities introduces the problems and theories concerned with longer cycles and with biotic balance or unbalance. To our way of thinking it is solely a matter of point of view whether we regard the community as being in the state of balance implied by the concept of dynamic equilibrium or think of it as being in perpetual unbalance. Both express the same general idea. It is significant that the periodic fluctuations in numbers may be conditioned by biotic interrelations as emphasized by the equations of Lotka and Volterra and/or by long-range environmental disturbances which may be either mundane or extra-mundane in origin. To sum up these relationships succinctly, they may be the result of the interplay of biotic potential, meaning the rate of increase, checked by environmental resistance which may be primarily an effect of the physical or of the biotic elements in the environment or of both acting together. We put the same idea into entirely biotic terms when we speak of the ratio between birth rate and death rate. Under many conditions these quantitative aspects of population growth are well summarized by the logistic curve of Verhulst and Pearl.

The increased crowding of animals often results in harm to the animals involved. This may produce a lowered survival and even extinction. This is one phase of the modern concept of the struggle for existence which is essentially a statistical principle and deals with changes in the birth-death ratio.

By the interaction of automatic cooperation and competition, that is through the activities involved in the struggle for existence, we come upon a whole set of ecological principles that center about organic evolution. This is a field which many modern ecologists appear to have avoided. All the factors of natural selection, *e.g.*, variation, overproduction, struggle for existence and the survival of the fittest are definitely ecological except for the important matter of the origin of those crucial variations which are not environmentally induced. At this one strategic point genetics has its only distinctive claim in the whole of the evolutionary field; otherwise, evolutionary dynamics belong in the realm of ecology.

Almost all other evolutionary principles are also ecological in nature: Lamarckian use and disuse, if these ideas have any place in modern thinking, Buffonian induction, orthogenesis in part and orthoselection wholly, and of course all isolation whether geographic, ecologic or physiologic in character. Subsidiary evolutionary theories such as sexual selection, mimicry and adaptive radiation are also wholly or mainly ecological.

Ecology deals not only with individuals and with communities of these individuals; it is concerned also with species and with their relations. This widespread, useful concept is in part an ecological tool and in part an expression of ecological forces. Among the ecological principles related to species there is another important rule of Jordan's that the nearest ally of a given species tends to occupy an adjacent area. This may be expanded to state that related and neighboring species tend to occupy separate niches and hence are in less direct competition than they would be otherwise. Stated with slightly different emphasis this takes consideration of the fact that the closest competitors of a given individual are the members of its own species; this forms the basis of territorial relationships such as have recently been much discussed, particularly among birds. The next closest competition for the individual comes from members of closely related species with similar ecological requirements. Hence related species find greater stability in their community relations if they occupy separate niches.

There is another set of principles that concern us which center about geographical distribution. Among these there is the generalization that vigorous species *tend to occupy more space the greater their age*; this is generally known as the age and area hypothesis and has limited application. Related to this is the extension that old races on the road towards extinction tend to be locally distributed over wide areas. Another related principle is the depth-age formulation of A. Agassiz, which states for oceanic life that forms with the greatest range in depth are those that show the greatest span in time. Among other principles of geographic ecology there is the tendency of the animals in the Arctic to resemble those in the Antarctic. This is usually called the principle of biopolarity. There is also the tendency for tropical oceanic communities to have fewer individuals per species as contrasted with the large numbers of individuals of the same species in colder waters. The fundamental principle of the relative stability of the present ocean basins, which limits our ideas concerning the extent and importance of land bridges, although still a matter of discussion, seems to be reasonably well established.

Then there are the principles related to emigration or dispersal, among which may be mentioned the suggestion of Matthew and Griffith Taylor that primitive animals tend to be located in remote corners of the world far from their centers of origin. Under other conditions, the primitive forms are located in the center of distribution which may or may not also be a center of origin and a center of survival.

In conclusion we recognize the inadequacy of the present presentation. We have not listed all those principles known to us as definitely ecological, and the selection has been uneven in quality. Possibly more relatively unimportant principles have been included than important ones omitted. Even this brief summary indicates that, plentiful as are the facts, there is no dearth of major and minor ecological principles about which to orient them. We trust that the analysis here presented and which may be elaborated in the future may contribute toward a more adequate synthesis of ecological knowledge. We believe that focusing attention on a theoretical framework will lead to more important work in ecology.

OBITUARY

STUART T. DANFORTH

1900–1938

ORNITHOLOGISTS, entomologists and naturalists who have visited Puerto Rico in the past dozen years will mourn the death of Dr. Stuart T. Danforth, which occurred at West Boylston, Mass., on November 25. Going to Puerto Rico soon after his graduation from Rutgers in 1921 to visit his father, Ralph E.

Danforth, who was professor of biology at the College of Agriculture at Mayagüez at that time, he commenced observations on the birds of the Cartagena Lagoon, which, supplemented by more intensive work in 1923–1924, constituted the field work of his doctorate thesis for which the degree was granted by Cornell in 1925. After a year as instructor in biology at Temple University, he succeeded his father at Mayagüez, and has taught zoology and entomology there since. In connection with his teaching he continued constantly studies and collections of birds and insects, especially Coleoptera, and studies in the food of birds, not only in Puerto Rico, but also in Hispaniola, Cuba, Jamaica and the Lesser Antilles, especially in those areas and islands most difficult to reach. His vacations were always thus occupied, except when he came to the United States to work in libraries and museums in connection with his various finds. Ordinarily one or more of his students accompanied him on his trips.

"The ultimate aim of ornithology, to my mind, is to make use of birds to the limit of their capacity as servants of man. I believe that eventually we will know so well how to encourage and protect birds that they will be practically one hundred per cent. efficient in protecting our forests and crops from insect pests, and that poisonous sprays and other protective measures will be unnecessary in the vast majority of cases." From this statement, one can possibly understand how it happened that he published no entomological papers, although the large number of "Danforth" and "AMC (Agriculture and Mechanics College)" records in "Insectae Borinquensis". testify to the extent of his insect collections in Puerto Rico and to his generosity in making them available for publication in another's compilation. Nearly every year, however, marked the appearance of a technical paper on the birds of one of the Lesser Antilles, but the culmination of all his ornithological observations in the West Indies was the publication in 1936 of the illustrated "Los Pájaros de Puerto Rico," a handbook supposedly for school children, but actually including all the information available; a most fitting summary of his chosen life-work. Some years ago he presented a collection of bird skins to Cornell, while the remainder of his extensive collection was given to the United States National Museum.

GEORGE N. WOLCOTT

RECENT DEATHS AND MEMORIALS

DR. RAYMOND A. PEARSON, since 1935 special assistant to the administrator of the United States Farm Security Administration, previously from 1926 to 1935 president of the University of Maryland, died on February 13 in his sixty-sixth year.

DR. WILTON EVERETT BRITTON, state entomologist of Connecticut since 1901 and head of the department of entomology of the Agricultural Experiment Station at New Haven, died at New Haven on February 15. He had celebrated his seventieth birthday on September 18 but continued at the station until he became ill a few weeks ago.

GEORGE CHARLES EMBODY, professor of agriculture at Cornell University, died on February 17. He was sixty-two years old.

DR. IVAN C. JAGGER, senior pathologist in the Bureau of Plant Industry of the U. S. Department of Agriculture, died on February 16. He was in his fiftieth year.

DR. J. C. FLIPPIN, professor of clinical medicine and dean of the Medical School of the University of Virginia, died on February 16 at the age of sixty-one years.

CHARLES RICHARD CRANE, manufacturer of Chicago and active in the diplomatic and political history of the United States, died on February 15 at the age of eighty years. Mr. Crane was known to the biologists of the country for his part in the development of the Marine Biological Laboratory at Woods Hole, where he had a summer residence.

ARTHUR SMITHELLS, from 1885 to 1923 professor of chemistry at the University of Leeds and from 1923 to 1937 director of the Salters Institute of Industrial Chemistry, died in London on February 8 at the age of seventy-eight years.

SIR ROBERT WILLIAM PHILIP, of Edinburgh, who was knighted in 1913 for his work in connection with tuberculosis, died on January 26. He was eighty-one years old.

Nature reports the death of Paul Séjourné, free academician of the Paris Academy of Sciences, who was known for his work on the design and structure of bridges, aged eighty-seven years, and of Professor Josef Simon, professor of roentgenology and radiology in the Masaryk University, Brno, aged forty-one years.

THE hundredth anniversary of the death of Josiah Willard Gibbs, who was born on February 11, 1839, was commemorated by Yale University on February 16 with a memorial lecture by Dr. Charles A. Kraus, research professor of chemistry at Brown University and president of the American Chemical Society. Gibbs, regarded by many as the greatest American scientific man, was born in New Haven in 1839 and was professor in Yale University from 1871 until his death in 1903.

SCIENTIFIC EVENTS

ARCHEOLOGICAL WORK OF THE UNIVERSITY OF NEBRASKA FOR 1938

THE field season of the Archeological Survey of the University of Nebraska was drawn to a close the first part of December. Through the cooperation of the Works Progress Administration work was conducted on a much larger scale than previously.

Three parties were in the field. One party, at O'Neill, excavated a group of eleven mounds containing both cremated and bundle burials, with pottery of the "Woodland" type and stemmed projectile points. After completing the work at O'Neill the party moved to a site south of Lynch, at the mouth of Redbird Creek, a tributary of the Niobrara. The site consisted of house pits, of the circular type, with pottery and artifacts almost identical to those found in a previous year at a historic Ponca village near Verdel. One unique characteristic of the pottery is tempering of burned and crushed bone. A preliminary report on Ponca archeology will be available next spring.

Another party worked at Stanton, near the Elkhorn River. This site consisted of circular house pits with artifacts similar to those of the Oneota culture and a profuse amount of European trade goods. No documentation in reference to this site has yet been found. We request the aid of experts to identify and date trade beads, porcelain ware, glass bottles and gun parts found in this site. After completion of this site the party worked in one of the many nearby Upper Republican sites.

A third party, at Ponca, first excavated a new focus of the Nebraska culture, and then moved to a "Woodland" site in the same locality. The site was in an old terrace remnant and consisted of three distinct culture strata separated by 32″ and 24″, respectively, of sterile soil. While the pottery of all the strata was of the "Woodland" type it showed a distinct evolution from a thick, crude ware at the bottom, to a fine, thin and well-finished ware at the top. The day that the project was closed a fourth stratum was located. Work on this important site will be continued next year.

EARL H. BELL

NATIONAL PARKS

IN connection with the proposal to make the Kings River Canyon of California a national park, Secretary of the Interior Ickes has made public a statement in which it is recommended that Congress establish and set standards for wilderness national parks, in which roads would be limited by law and from which hotels would be excluded. The statement follows:

> In 1935 I issued a statement of policy, declaring the purpose of the department, if this national park is authorized by Congress, to treat it as a primitive wilderness, limiting roads to the absolute minimum, maintaining foot and horse trails, excluding elaborate hotels, admitting all responsible packers, promoting good fishing, endeavoring to restore such nearly vanished wild life as the Sierra bighorn, the southern wolverine and the Pacific fisher; also to respect all valid existing equities, make every effort to conserve the watershed and recreational values of the region, and seek boundaries which will attain these ends without infringing upon the future development of the Kings River, for water storage, power and other uses, necessary to the welfare of the people of the San Joaquin Valley.
>
> These principles of administration I wish to reaffirm. Since 1935, the Olympic National Park has been established and most of the lands have been acquired for the authorized Isle Royale National Park. Both will be maintained as wilderness areas. The problems of administration arising in connection therewith, and the questions arising in connection with the proposed Kings Canyon National Park, point to the need for a greater stability of policy than can be insured by administrative orders. Areas dedicated as wilderness national parks should be protected forever by provisions of law designed for that purpose, this in addition to the protection all national parks receive by law against commercial activities.
>
> I shall welcome it if the Congress of the United States will define and set standards for wilderness national parks, as well as provide for wilderness areas to be proclaimed and similarly protected by law in other national parks. I suggest the following statutory safeguards for the Kings Canyon National Park if and when it is established:
>
> 1. Prohibit by law the building of any roads or truck trails in the park, except on the floor of the valley of the South Fork of the Kings River, below its junction with Roaring River.
> 2. Require that all buildings in the park shall be erected with government funds.
> 3. Exclude all public housing structures, except trailside shelters, from the park, except in the valley of the South Fork of the Kings River below Roaring River, allowing in that area simple cabins which may be rented to visitors, but not leased.
> 4. Permit public and private packers to use the park without discrimination, subject to general regulations.
> 5. On account of the relative absence of automobile roads, provide that the existing Sequoia-General Grant automobile fee shall admit to Kings Canyon.
>
> By these policies, written into law, the Kings River wilderness can be maintained forever in its present grandeur, and dedicated to recreational use consistent with its wilderness aspect.

THE ANNUAL REPORT OF THE DIRECTOR OF THE NEW YORK BOTANICAL GARDEN

DR. WILLIAM J. ROBBINS, director of the New York Botanical Garden, in his first annual report calls special attention to the completion of the reconstruction of the main observatory, the establishment of a new laboratory for the study of vitamins and their functioning in the growth of plants, and the addition of more than 45,000 specimens to the herbarium among the achievements of 1938.

Figures collected in various departments indicate that the public had made greater use of the garden in the past year than at any time in recent years. Record crowds have visited the plantings both outdoors and in the newly reopened conservatory, and more people than usual have registered for gardening courses and attended the free Saturday lectures. On a single holiday, for example, 8,500 people viewed the perennial border, while 2,000 strolled through the Thompson Memorial Rock Garden, many of them taking notes on the plants which especially interested them, and on the same day, 2,500 persons walked through the three houses which were then open in the conservatory, examining the collection of cacti and other succulents.

For next year's displays, 2,500 tulips have been planted in the conservatory court, and 7,600 biennials are being raised for later bedding effects there. One hundred new varieties of iris in bearded, bulbous, Japanese and Siberian types, besides 15 natural species, totaling nearly 2,000 plants, are being added. During the past year, the Thompson Memorial Rock Garden has been enriched by 1,300 plants which were propagated by the garden, plus 450 received from other sources. Five thousand new bulbs have been planted there for an additional spring display. In the glade 300 lilies and 150 other plants have been set out for naturalizing. These plantings mark the beginning of the flowering meadow being created there. East of the rock garden, in the woods, a native flower area is being developed, and to this 500 plants were added during the year.

The department of plant pathology, under Dr. B. O. Dodge, has succeeded during the past year in reducing the infections of the Japanese beetle, the gipsy moth and the Dutch elm disease at the garden. Other scientific work includes work in genetics being done under the direction of Dr. A. B. Stout, including the development, in collaboration with the New York Agricultural Experiment Station at Geneva, of hardy seedless grapes for the northeastern states. The work on vitamins and plant growth is being directed by Dr. Robbins himself.

The herbarium, which now numbers 1,933,506 specimens, has been used during the past year by visiting botanists from thirty-four institutions in this country and abroad. In addition, collections of plants have been identified for botanists in eleven foreign countries and thirteen states, and loans have been made for study to the extent of nearly 15,000 specimens, sent to institutions in twenty-one states and seven foreign countries.

The library, under Miss Elizabeth Hall, with Dr. J. H. Barnhart as bibliographer, has been consulted this year by botanists and horticulturists from more than thirty states, territories and possessions and from nineteen foreign countries representing every continent. In addition, students from more than a hundred schools, colleges and institutions have used the library during the year, some for only a day but others for several weeks or longer.

Officers of the New York Botanical Garden, all of whom were reelected at the annual meeting, are Joseph R. Swan, *president;* Henry de Forest Baldwin and John L. Merrill, *vice-presidents;* Henry de la Montagne, *secretary;* and Arthur M. Anderson, *treasurer.* Mrs. Harold I. Pratt was elected to the board on January 12. Dr. E. C. Auchter, chief of the U. S. Bureau of Plant Industry, became a member just before the close of the year.

A CENTER FOR MATHEMATICAL ANALYSIS AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

THE establishment of a center of mathematical analysis to direct the use of new types of calculating machines at the Massachusetts Institute of Technology has been made possible by a grant of $45,000 by the Carnegie Corporation of New York.

The center of mathematical analysis is being founded primarily for the purpose of encouraging and assisting technological advance in all fields by making available to scientific institutions and industry the means of carrying out intricate mathematical processes economically. The center will also carry out an active development program on new machines and the analytic methods of using them.

Recommended by the Committee on Scientific Aids to Learning of the National Research Council, the project includes the organization of a staff to operate the various machines developed at the institute. The program is to be centered in the department of electrical engineering in the new Rogers Building under the direction of Professor S. H. Caldwell.

As the scope of science and engineering has been developed and extended, the problems arising have increased in complexity and the associated mathematical labor has grown proportionately. Ordinary methods of analysis have either failed completely to keep up with this development or have given results only at the expense of much tedious routine computation. By means of the more recently developed types of machines, direct attack on problems is frequently possible and the routine labor is eliminated.

Equipment which will be available for use through the center of mathematical analysis will include the original differential analyzer and a new, larger, faster and more accurate differential analyzer which is now under development at the institute, both of which make possible the solution of many difficult problems involving differential equations and integrations; the cinema-integraph; the network analyzer; the simultaneous calculator; a group of punched-card machines and miscellaneous types of commercial and special machines.

Organization of the center will be started at once and it is expected to be in operation next fall.

IN HONOR OF HAVELOCK ELLIS

THE following statement commemorating the eightieth birthday of Havelock Ellis on February 2 has been signed among others by Professor John Dewey, of Columbia University, and by Professor Adolf Meyer, professor of psychiatry of the Johns Hopkins University.

Havelock Ellis was born eighty years ago, on February 2, 1859, in Surrey, England, the son of a British seaman, and the last of a long line of English clergymen, mariners and merchants. Though Ellis is known for the wide range of his culture and interests, for his distinction as critic and writer, for his rare personal charm, and for his broad humanity, he will perhaps be best and longest remembered for the work to which, at an early age, he had dedicated his life and energy—that of bringing human sex psychology within the scope of science. His seven monumental volumes of "Studies in the Psychology of Sex" have probably served more than any other single work to bring sex out of the atmosphere of ignorance and prudery into the clear light of science, and will always remain an incomparable critical digest of the scientific knowledge of the subject up to contemporary times.

The scientific study of sex is nowadays accepted almost without question, but the destruction of the old taboos and prejudices was not accomplished without hardship and sacrifice. The appearance of Ellis's first volume of the Studies in 1897 was followed by a prosecution for the distribution of what the judge described as a "filthy publication." The sale of the book was suspended in England, but it is a matter of pride to American scientists that the Studies could thereafter be published in this country. "I am a student," wrote Ellis in his memorable Note on the Bedborough Trial, "and my path has long been marked out. I may be forced to pursue it under unfavorable conditions, but I do not intend that any consideration shall induce me to swerve from it." His life achievement is the best testimony to the success of this early resolve.

We hope that Havelock Ellis will for many years continue to exercise his great and good influence. His life and work remain an inspiration not only to us but to future generations as well.

AWARDS OF THE AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS

AT the annual dinner on February 15 of the American Institute of Mining and Metallurgical Engineers the William Lawrence Saunders Medal for distinguished achievement in mining was presented to Louis Shattuck Cates, copper-mining engineer and president of the Phelps Dodge Corporation. The award to Mr. Cates was "for signal accomplishment in the conception and application of superior mining technique and in the organization and administration of major mining and metallurgical enterprises."

The Robert Woolston Hunt Award was presented to Professor John Chipman, of the Massachusetts Institute of Technology, and Kenneth C. McCutcheon, of the American Rolling Mill Company, Ashland, Ky., for their paper on "Evolution of Gases from Rimming Steel Ingots."

The Institute of Metals Division Award for 1939 was presented to Assistant Professor Frederick N. Rhines and Robert F. Mehl, director of the metal research laboratory, both of the Carnegie Institute of Technology, Pittsburgh. The award was for their paper on "Rates of Diffusion in Alpha Solid Solutions of Copper."

The Alfred Noble Prize, for a paper by an author under 31 years old, was presented to Ralph J. Schilthuis, of the Humble Oil and Refining Company, Houston, Texas, for his paper on "Connate Water in Oil and Gas Sands."

Daniel Cowan Jackling, president of the institute, was toastmaster. Donald B. Gilles was inducted as president of the institute for 1939. The dinner was attended by approximately 1,200 persons.

SCIENTIFIC NOTES AND NEWS

THE seventy-sixth annual meeting of the National Academy of Sciences will be held in Washington on April 24, 25 and 26. The first lecture to be delivered in America under the Pilgrim Trust will be given by Sir William H. Bragg, president of the Royal Society, on Monday evening, April 24, at 8:30 P.M. Dr. Irving Langmuir, of the Research Laboratories of the General Electric Company, gave the corresponding lecture in London on December 28. The Pilgrim Trust, established in England by Edward S. Harkness, provides funds for the exchange of lecturers on alternate years between the National Academy of Sciences and the Royal Society.

DR. FRANK SCHLESINGER, director of the Yale University Observatory, has been elected foreign correspondent of the French Bureau des Longitudes, in succession to the late George Ellery Hale.

Rockford College, Illinois, conferred on February 18 the honorary degree of doctor of laws on Dr. Frank B. Jewett, president of the Bell Telephone Laboratories. The degree ceremony preceded the Maddox Foundation lecture given by Dr. Jewett, which was entitled "Changes in Society brought about by Science."

Dr. Elmer V. McCollum, since 1917 professor of biochemistry at the School of Hygiene and Public Health of the Johns Hopkins University, has received the annual award of the Associated Grocery Manufacturers of America for outstanding contributions to the scientific knowledge of foods.

Dr. David Fairchild, collaborator of the Division for Plant Introduction of the U. S. Department of Agriculture, was presented at a luncheon given on February 12 at the Hotel Astor, New York City, with one of the four annual awards of the American Booksellers Association for his autobiography entitled "The World was My Garden."

The Paul Fourmarier Prize and gold medal of the Royal Academy of Belgium has been awarded to M. L. Cayeux, member of the Paris Academy of Sciences, honorary professor of geology at the Collège de France.

M. Gaston Louis Ramon, sub-director of the Pasteur Institute of Paris, has been made a Commander of the Legion of Honor for his work on immunization against diphtheria and tetanus and combined inoculations.

Dr. Max Dessoir, professor of philosophy at the University of Berlin, celebrated the fiftieth anniversary of his doctorate on February 2.

Dr. Samuel J. Record, professor of forest products at Yale University, has been appointed dean of the School of Forestry. He will succeed Dr. Henry S. Graves, who will retire from active service at the end of the college year after serving as dean of the school and Sterling professor of forestry since 1922. Dr. Graves has been a member of the faculty of the university for thirty-one years and was provost from 1923 to 1937.

The title of emeritus professor has been conferred on Professor E. S. Salmon, formerly university professor of mycology at the South-Eastern Agricultural College, London, and on Professor P. G. H. Boswell, who has retired from the chair of geology in the Imperial College of Science and Technology.

Three new professorships have been established at the Rensselaer Polytechnic Institute at Troy, N. Y.: the Russell Sage professorship of mechanical engineering, to be filled by Edwin Allan Fessenden; the Robert W. Hunt professorship of metallurgical engineering, to be filled by Matthew Albert Hunter, and the William Weightman Walker professorship of geodesy and transportation, to be filled by Howard Oakley Sharp.

Dr. John A. Hartwell, past president of the New York Academy of Medicine, who will resign as director of the academy on April 1, has been appointed associate director of the American Society for the Control of Cancer.

Dr. Aaron J. Rosanoff, since 1923 member of the Los Angeles County Lunacy Commission, has been appointed director of the state institutions of California.

Dr. James D. Hardy has been promoted to the position of research associate in the Russell Sage Institute of Pathology.

L. Bryant Mather, Jr., has been appointed assistant curator of mineralogy at the Field Museum of Natural History.

Dr. Paul Herget, of the Observatory of the University of Cincinnati, has become a member of the commission on minor planets, comets and satellites of the International Astronomical Union. He will aid the commission in the computation of the orbits of asteroids.

Dr. Louis A. Julianelle, in charge of trachoma research at Washington University, St. Louis, will leave shortly for the Navajo reservation in Arizona and New Mexico to resume his study of the eye disease among the Indians. The Commonwealth Fund has supported the research for ten years.

Professor W. F. C. Ferguson, who had leave of absence from the department of physics of the Washington Square College of New York University, has returned to New York from the University of California, where he has been carrying on research on band spectra.

On the evening of February 7, the Royal Society, London, combined with the British Academy to give a reception to the exiled scholars and scientific men now under the care of the Society for the Protection of Science and Learning (the late Academic Assistance Council). The guests were received at Burlington House by Sir William Bragg and Sir Frederic Kenyon, and the Archbishop of York replied to the welcome on their behalf. On February 8 at Cambridge, the vice-chancellor of the university presided at a meeting addressed by Earl Winterton and Professor A. V. Hill. On February 10 at Oxford the vice-chancellor of the university presided at a meeting addressed by Viscount Samuel and Sir John Hope Simpson. Sir William Bragg spoke at Liverpool and Sir Henry Dale at Glasgow.

THE following members have been appointed by the Scottish Advisory Committee on Cancer: William James Stuart, *chairman;* Geoffrey Balmanno Fleming, Henry Lumsden Forbes Fraser, Alexander Stuart Murray Macgregor, David Robertson, John James McIntosh Shaw, William James Stuart and A. J. Purves, *secretary.* The committee has been set up to review existing facilities for the diagnosis and treatment of cancer, to recommend what developments are desirable, and to suggest how far and in what groupings local authorities could with advantage act together in securing that arrangements for diagnosis and treatment are adequate for the needs of their areas.

THE British Minister of Labor has appointed an advisory council, with Sir Walter Moberly as chairman, to advise him on the utilization in war-time in government departments or elsewhere of persons with scientific, technical, professional and the higher administrative qualifications. Among those who have accepted membership are: H. L. Eason, principal of the University of London; Sir Edward Mellanby, secretary of the Medical Research Council, and Professor A. V. Hill, Foulerton research professor of the Royal Society, London.

THE twenty-seventh course of Lane Lectures at Stanford University will be given from May 22 to 26 by Dr. Thomas M. Rivers, director of the Hospital of the Rockefeller Institute for Medical Research. The general title for the series will be "Viruses and Virus Diseases."

DR. HERBERT J. SPINDEN, of the Brooklyn Museums, delivered the eighth Arthur Lecture under the auspices of the Smithsonian Institution in the U. S. National Museum on February 21. He spoke on "Sun Worship."

DR. ROY GRAHAM HOSKINS, director of research at the Memorial Foundation for Neuro-Endocrine Research at the Harvard Medical School, gave the Laity Lecture on February 9 at the New York Academy of Medicine. His subject was "The Story of Mental Diseases."

THE fifty-fifth annual meeting of the American Association of Anatomists, by invitation of Harvard University, Boston University and Tufts College, will be held in Boston at the Harvard Medical School, on April 6, 7 and 8. Arrival on the evening of April 5 is suggested for an informal social meeting at the headquarters, the Hotel Somerset, or at the Boston Medical Library near by, where rare early anatomical works will be exhibited. The American Association of Physical Anthropologists will conclude its session at the Wistar Institute on April 5, making it as convenient as possible to attend both the Philadelphia and Boston meetings.

THE hundredth anniversary of the discovery of the cell was commemorated by a meeting of the Section on Medical History of the College of Physicians of Philadelphia on February 13. From the School of Medicine of the University of Pennsylvania, Dr. W. H. F. Addison, professor of histology and embryology, spoke on "Early History of the Discovery of the Cell"; Dr. E. B. Krumbhaar, professor of pathology, on "Rudolph Virchow and Cellular Pathology," and Dr. J. Harold Austin, professor of research medicine, on the "History of the Chemistry of the Cell." Dr. Ethel Browne Harvey (by invitation), investigator, department of biology, Princeton University, spoke on "Division and Development of Eggs without Nuclei." An exhibit illustrating the subject was open in the evening.

A CORRESPONDENT writes: "The Association Préhistorique des Amis des Eyzies is organizing a celebration in honor of M. Denis Peyrony upon his reaching the age of seventy years. The celebration will take place at Les Eyzies, Dordogne, France, on Palm Sunday, April 2, when a bronze medallion portrait of M. Peyrony will be unveiled at the Prehistoric Museum. American colleagues and admirers will be welcome at the ceremony. Those wishing to aid in this expression of esteem and of appreciation of all that he has achieved for prehistoric archeology in forty years of digging and research, as well as of his unfailing helpfulness and courtesy to American and other foreign archeologists visiting Les Eyzies and the caverns of Dordogne, may participate by sending a subscription which has been set at a minimum of 50 francs, equal at present to $1.35. Checks should be made to the order of H. H. Kidder, treasurer, Care Morgan and Company, 14 Place Vendome, Paris."

DURING the early expeditions of the American Museum into the Morrison Jurassic beds of the western United States, many large separate dinosaur bones, mostly sauropods, were collected, which subsequently have been represented by skeletons. It has become necessary to discard a considerable amount of this material which would have great teaching value to schools and colleges and much exhibitional value to institutions that display natural history objects. Most of these bones are in their original plaster of paris field wrappings, but could be prepared by recipients at a nominal expense. They include large limb bones, foot bones, ribs and vertebrae. Specimens will be sent gratis to schools and societies that will pay freight, drayage and the expense of boxing. This material is now available, and a list of specimens may be obtained by writing to Dr. Barnum Brown, American Museum of Natural History, New York City.

AT the eighth annual meeting of the Academy of Pediatrics in 1938, the offer of Mead Johnson and Company to establish the E. Mead Johnson Award for

Research in Pediatrics for a period of ten years was accepted. An academy committee on awards was appointed, consisting of: Drs. Joseph Brennemann, Chicago; Irvine McQuarrie, Minneapolis; Oscar M. Schloss, New York; Edwards A. Park, Baltimore, and Borden S. Veeder, St. Louis (*chairman*). The committee announces the following rules and regulations governing the award: Two awards, one of $500 and one of $300, will be given annually at the annual meeting of the Academy of Pediatrics; the awards will be made for research work published during the previous calendar year; there is no limitation as to the type or scope of the research except that it be in the field of pediatrics; the award is limited to workers in the United States and Canada; the award shall be limited to investigators who have been graduated not more than 15 years previous to the publication of the research; there is no restriction as to the journal of publication of the research. The award in 1939 will be given for research published during the period January 1, 1938, through December 31, 1938, by a graduate of 1923 or later. The award in 1940 will be given for research published January 1, 1939, through December 31, 1939, by a graduate of 1924 or later, and so on for subsequent years.

THROUGH the bequest of the late William Campbell, for many years Howe professor of metallurgy at Columbia, there have been established the William Campbell fellowships, primarily for scientific research in the field of metals. These fellowships become available for the first time for the academic year 1939–40 for graduate study and research at Columbia University. They carry stipends up to $1,200 per annum as determined by the Campbell Fellowship Committee. Applications accompanied by certified transcripts of academic records, proposed research projects and proposed fields of graduate studies should be filed with the Dean of Engineering, Columbia University, New York City, before March 15.

THE Graduate School of the University of Illinois announces the establishment of four research fellowships to be awarded for one year in the fields of medicine and dentistry in Chicago at a stipend of $1,200 per year (calendar year with one month's vacation). Fellows are eligible for reappointment in competition with the new applicants. Candidates for these fellowships must have completed a training of not less than eight years beyond high school graduation. Applications should be made before March 1. Announcement of the fellowship awards will be made on April 1, becoming effective on September 1. Applications should be made before March 1 to the secretary of the Committee on Graduate Work in Medicine and Dentistry, 1853 W. Polk Street, Chicago, Ill.

ACCORDING to a correspondent of the *Journal* of the American Medical Association, the Association of Physicians in Poland has taken strong action to withdraw Jews from the medical profession. A deputation of the association appealed to the medical departments of all Polish universities not to admit Jews. The demands have been partially followed by the universities. The percentage of Jewish candidates admitted lately to the medical departments in all Poland amounts only to 3.7.

DISCUSSION

DO THE ISOTOPES OF AN ELEMENT HAVE IDENTICAL CHEMICAL PROPERTIES?

THE answer to this question has definitely changed in the last few years. For many years it has been erroneously concluded that the chemical properties of isotopic molecules were exactly identical in every respect. Text-books published within the last year even carry such statements. Many scientists engaged in other fields of research are not aware of recent developments which have changed the answer to this question. In view of recent theoretical calculations and important and dramatic successes in the separation of a number of isotopes by chemical means, our old concept will certainly require some modification. The isotopes of hydrogen, nitrogen, carbon, oxygen, lithium and potassium have all been shown, through fractionation by chemical means, to have small differences in their chemical characteristics.

Since all the isotopes of an element have the same atomic number, that is, the same number of external electrons, we expect them to have the same *kind* of chemical properties, but since the atomic mass is different, we may expect a small difference in the rate or extent to which certain reactions take place. This is what has been found to be true. After the discovery and separation of the hydrogen isotopes, these differences were abundantly verified. Since the mass of deuterium is twice that of hydrogen and since the energy content of their molecules is markedly different, we should expect differences to occur particularly in such properties as rate of reaction, equilibrium states, electrolytic separation and biological behavior. Differences in the rate or extent of various reactions have been found to be from a few per cent. to over a thousand per cent.

The failure for many years to achieve a separation of other isotopes by chemical means led to the erroneous conclusion that their chemical behavior must be exactly identical. Some years ago it was pointed out on theoretical grounds that there should be small differences in chemical behavior, and in 1935 Urey and Greiff made calculations for a whole series of isotopic chemical exchange reactions, a number of which have been used in attempts to separate the isotopes of the lighter elements. Among the two-phase gas-liquid chemical reactions which Urey and his co-workers have succeeded in obtaining some fractionation of the isotopes are: (1) The reaction of ammonia gas with ammonium ion in solution; (2) the reaction of ammonia gas with solvated ammonia in water and in alcohol; (3) the reaction of sulfur dioxide gas with bisulfite ion in solution; (4) the reaction of carbon dioxide with bicarbonate ion in solution. In all these cases the heavier isotope prefers to form the ion and is therefore concentrated in the solution. In this respect the heavier isotope is slightly different chemically from the lighter isotope. The fractionation factors α, which in these cases are the same as the equilibrium constants, give a measure of the chemical differences and are as follows:

$$(1)\quad N^{15}H_3 + N^{14}H_4^+ \leftrightarrows N^{14}H_3 + N^{15}H_4^+ \qquad \alpha = 1.021$$

$$(2)\quad N^{15}H_3 + N^{14}H_{3(aq)} \leftrightarrows N^{14}H_3 + N^{15}H_{3(aq)} \qquad \alpha = 1.006$$

$$(3)\quad S^{34}O_2 + HS^{32}O_3^- \leftrightarrows S^{32}O_2 + HS^{34}O_3^- \qquad \alpha = 1.015$$

$$(4)\quad C^{13}O_2 + HC^{12}O_3^- \leftrightarrows C^{12}O_2 + HC^{13}O_3^- \qquad \alpha = 1.014$$

These differences are of the order of 1 to 2 per cent. compared to 300 per cent. to 1000 per cent. for the electrolytic separation of hydrogen and deuterium. However, with sufficient repetition of these equilibrium stages in a counter-current system, appreciable separation of the isotopes can be achieved. By use of reaction (1) Dr. Thode, Dr. Urey and their co-workers at Columbia University have recently announced that they have increased the concentration of N^{15} from 0.3 per cent. to 73 per cent., a remarkable accomplishment and an important one particularly for biological studies.

Lewis and Macdonald, of the University of California, using a counter-current flow of lithium in a mercury amalgam and lithium chloride in an ethyl alcohol solution, increased the concentration of Li^6 from 8 per cent. to about 16 per cent. The Li^6 was preferentially held in the amalgam and in this respect is slightly different chemically from Li^7. A number of investigators, including the present author, have studied the electrolysis of lithium from salt solutions into flowing mercury electrodes. Differences in the rate of discharge of the isotopes ranging from 2 per cent. to 7 per cent. have been observed. These differences are very much smaller than for electrolytic separations of hydrogen and deuterium, but are indeed real.

The present author in collaboration with Dr. Urey has also succeeded in obtaining a small fraction of the lithium and potassium isotopes by chemical exchange with zeolites. Zeolites are complex alkali alumino-silicates commonly used in water softening. The alkali ion is replaceable by other positive ions, and one isotope of lithium, for example, replaces sodium better than the other:

$$Li^+ + Na\ Zeolite \leftrightarrows Li\ Zeolite + Na^+$$

The differences are again small, but by use of a 100-foot column, appreciable changes in the isotope ratio were produced. Further studies on these zeolite reactions and other similar reactions are being carried out at the University of Minnesota in attempts to obtain a larger separation of the biologically important and significant potassium isotopes.

It is indeed fortunate that the isotopes of an element all undergo the same *kind* of chemical reaction, otherwise their use in "exchange reactions" and "tracer" reactions would be impaired. By determining the extent to which a light isotope exchanges with a heavy isotope in contact with a molecule, one is in a position to say something about the binding or reactivity of the exchanging atoms. Groups containing the heavy isotope may be followed from one molecule to another in order to determine structure or reaction mechanisms. By synthesizing fats containing heavy hydrogen or carbon, or amino-acids and proteins containing heavy nitrogen or sulfur, or drugs or other chemicals, we may tag or label the molecule and trace it through biological processes. All we have to do is put it in the molecule such that it will not easily leave and exchange for the lighter isotopes. By analysis of different parts of the animal for the heavy isotope, we can determine where the substances fed or injected have gone. This is an example of a tracer reaction in biological chemistry, a very important new tool in the study of nutrition, biology and medicine.

We may conclude, therefore, that while the isotopic compounds of the lighter elements have a sufficient difference in chemical characteristics to afford a separation by chemical means (difficult as it may be), the differences are not sufficient to interfere with their valuable use in tracer and exchange reactions.

T. IVAN TAYLOR

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SPAWNING OF OSTREA VIRGINICA AT LOW TEMPERATURES[1]

SINCE the end of the last century it has been generally accepted among aquatic biologists that under natural conditions the eastern oyster (*O. virginica*) may spawn only when the water temperature reaches

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[1] Published with the permission of the U. S. Bureau of Fisheries.

20.0° C. or higher (Townsend, Stafford, Churchill, Prytherch and others).[2, 3, 4, 5] These field observations were confirmed in the laboratory by Galtsoff,[6, 7] who stated that the results of his extensive experiments with *O. virginica* showed that no spawning occurred below 20.0° C. However, the writer's observations of the last two summers on the spawning of oysters in Long Island Sound indicate that spawning may take place at temperatures several degrees lower than the so-called critical temperature of 20.0° C. In 1937 the initial and general spawning of the oyster population of the Sound, living in water from 1 to 25 feet, took place on and about July 3. The date of spawning was ascertained by Mr. James Engle and the writer by the age of oyster larvae found in the water, by the time of the beginning of oyster setting and, chiefly, by gross and histological studies of oyster gonads. The last method provided infallible proof that the gonads of oysters were partly discharged. The bottom water temperature several days prior to and during spawning time ranged from 17.5 to 18.5° C.

In 1938 the first spawning of oysters occurred on June 28, far ahead of the expected time. At one of our stations located in 30 feet of water, half of the oysters examined were found with partly discharged gonads, although the highest bottom temperature recorded at that station prior to and at the beginning of spawning was only 16.4° C. The highest temperature recorded at any of our 15 sampling stations, distributed over a distance of 30 miles of the oyster-producing section of the Sound, was 18.3° C. The average bottom water temperature of all 15 stations was 17.0° C. To avoid any errors in recording, the water temperature measurements were taken simultaneously with four deep-sea reversing thermometers, their correctness verified by the U. S. Bureau of Standards. The temperature was read by two investigators. At the invitation of the writer, Dr. P. S. Galtsoff, of the U. S. Bureau of Fisheries, was present on the investigation trip on June 30 and confirmed the fact that oysters spawned at temperatures lower than 20.0° C.

The observations of the last two summers refute the method advanced by Prytherch[8] for predicting one month in advance the time of spawning. His method is based upon the assumption that the spawning of oysters can not occur at a temperature lower than 20.0° C. Evidently, some other factors, undetermined at present, are involved in inducing the spawning of oysters at low temperatures. Until these factors and their role in stimulating the shedding of sex cells can be ascertained, no infallible method for predicting the time of spawning of oysters living under natural conditions can be advanced.

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HANDEDNESS OF TWINS

THAT the members of an occasional pair of identical twins differ in unimanual handedness is a well-established fact. The reasons for such reversals, however, have long been a matter of controversy. Newman and his school believe such reversals occur in those pairs in which division of the embryo occurred relatively later in embryonic development than in those pairs in which no reversals are manifest. The supposition is that in the former instance certain irreversible developments have taken place prior to separation of the embryos, thus one resulting embryo would be similar to the right and the other to the left side of what would have been a single individual had no separation taken place. According to this system of reasoning, identical twins showing less similarity in general appearance should show more reversals in handedness and other bilateral traits. The above theory has met with considerable criticism by various students of twins, in that no significant correlation has ever been shown to exist between the general similarity in features and appearance and the degree of reversal in handedness.

For several years the writer has noted that in both identical and fraternal twins showing reversals in unimanual handedness, an apparently high percentage of such pairs have one or more left-handers among their immediate relatives. An opportunity to obtain a considerable amount of pertinent data was afforded the writer by an invitation to attend a recent[1] twin party at Waterville, Maine. The party was sponsored by Mr. Welton P. Farrow to celebrate the visit of his identical twin brother, whom he had not seen for nineteen years.

Close to two hundred pairs of twins attended the party. The finest cooperation was given to the writer and his assistants, and data were obtained on the unimanual handedness of 109 pairs of twins and their immediate families. These data, plus data previously obtained, were sufficient to permit a statistical analysis.

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[2] C. H. Townsend, Rept. U. S. Fish. Comm. for 1889–91, 345–348.

[3] J. Stafford, Comm. of Conservation, Canada, 1–159, 1913.

[4] E. P. Churchill, Rept. U. S. Fish. Comm. for 1919, 1–51, 1921.

[5] H. F. Prytherch, Appendix 11, Rept. U. S. Fish. Comm., Doc. 961, 1–14, 1923.

[6] P. S. Galtsoff, *Collecting Net*, 4: 10, 277–278, 1931.

[7] P. S. Galtsoff, *Proc. Nat. Acad. Sci.*, 16–9, 555–559, 1930.

[8] H. F. Prytherch, *Bull. U. S. Bur. Fish.*, 44, 429–503, 1929.

[1] Held on August 16, 1938.

Out of a total of 82 pairs of identical twins alike in handedness, 19 pairs or 23.1 per cent. have one or more left-handed relatives in their immediate families. Out of a total of 20 pairs of identical twins showing reversals in handedness, 11 pairs or 55 per cent. have one or more left-handed relatives in their immediate families. The difference in the percentage occurrence of left-handed relatives of the two groups is 31.9 per cent. ± 11.37,[2] a significant amount.

Interestingly enough, the same type of analysis of fraternal twins gave strikingly similar results. Out of a total of 50 fraternal pairs having the same handedness, 9 pairs or 18 per cent. have one or more left-handers in their immediate families, whereas among fraternals showing reversals in handedness, 8 out of 14 pairs, or 57.1 per cent., have left-handers in their immediate families. Here the difference in the percentage occurrence of left-handers among the relatives of the two groups is 39.1 per cent. ± 14.09, again a significant difference.

These findings thus indicate conclusively in both types of twins that left-handedness occurs more frequently among the relatives of those pairs showing reversals than among the relatives of pairs alike in unimanual handedness. The most probable explanation would seem to be that handedness is a quantitative trait and that in embryos which are genotypically near ambidexterity, if twinning occurs, the unusual position in utero is sufficient to shift handedness one way or the other. We should naturally expect to find a higher percentage of such genotypes in families with left-handers. In fraternal twins, of course, we have somewhat different heredities in the members of a pair and might thus expect to find a higher percentage of reversals than in identicals, who have the same genotype.

In a total of 139 pairs of identicals, we found 22 pairs or 15.8 per cent. to have reversal in handedness, whereas in 81 pairs of fraternals, 18 pairs or 22.2 per cent. Thus, according to our data, reversals occur in 6.4 per cent. ± 5.3 more cases of fraternal than identical twins. While this difference is not sufficient to be statistically significant, it rather definitely refutes the contention of some to the effect that reversals in handedness occur more frequently in identical than in fraternal twins.

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"MANIFESTO" BY A PHYSICIST

MANY scientists must have been profoundly disturbed by the revelations of recent events as to what the implications of the totalitarian philosophy of the state really are. There would seem not to be room on the same planet for totalitarian states and states in which the freedom of the individual is recognized. Many scientists must have been moved to try to find something to do about it. In my own case this urge to find something to do has resulted in the decision to close my laboratory to visits from citizens of totalitarian states. I have had the following statement printed, which I hand to any prospective visitor who may present himself.

Statement

I have decided from now on not to show my apparatus or discuss my experiments with the citizens of any totalitarian state. A citizen of such a state is no longer a free individual, but he may be compelled to engage in any activity whatever to advance the purposes of that state. The purposes of the totalitarian states have shown themselves to be in irreconcilable conflict with the purposes of free states. In particular, the totalitarian states do not *recognize that the free cultivation of scientific knowledge for its own sake* is a worthy end of human endeavor, but have commandeered the scientific activities of their citizens to serve their own purposes. These states have thus annulled the grounds which formerly justified and made a pleasure of the free sharing of scientific knowledge between individuals of different countries. A self-respecting recognition of this altered situation demands that this practice be stopped. Cessation of scientific intercourse with the totalitarian states serves the double purpose of *making more difficult the misuse of scientific information* by these states, and of giving the individual opportunity to express his abhorrence of their practices.

This statement is made entirely in my individual capacity and has no connection whatever with any policy of the university.

Science has been rightly recognized as probably the one human activity which knows no nationalisms; for this reason it has been a potent factor making for universal civilization. Action such as this is therefore to be deeply deplored and to be undertaken only after the gravest consideration. But it seems to me that the possibility of an idealistic conception of the present function of science has been already destroyed, and the stark issues of self-survival are being forced upon us. Perhaps the only hope in the present situation is to make the citizens of the totalitarian states realize as vividly and as speedily as possible how the philosophy of their states impresses and affects the rest of the world. Such a realization can be brought about by the spontaneous action of the individual citizens of the non-totalitarian states perhaps even more effectively than by their governments. Here I think is one of the few conceivable situations in which the popular conception of the social "responsibility" of "science" can touch at all closely the individual scientist.

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[2] S.E. difference.

SOCIETIES AND MEETINGS

THE FIFTH WASHINGTON CONFERENCE ON THEORETICAL PHYSICS

THE theory of low-temperature physics was the focal point of discussion held in Washington from January 26 to 28 under the joint auspices of the George Washington University and the Carnegie Institution of Washington, acting through its Department of Terrestrial Magnetism. The properties of liquid helium and of liquid hydrogen and deuterium, the interpretation of data on the adiabatic demagnetization of paramagnetic salts at temperatures below 1° K and the phenomenon of superconductivity were the subjects discussed. In addition, the theory of certain very recent developments in nuclear disintegration of atoms and the theory of nuclear binding forces were discussed. Professors Niels Bohr, Harold C. Urey, Enrico Fermi, F. London, G. E. Uhlenbeck, J. H. Van Vleck, H. A. Bethe, G. Breit, E. U. Condon, I. I. Rabi, A. E. Ruark, F. Bitter, H. Grayson-Smith, F. Seitz, O. Stern, L. Rosenfeld and many other physicists active in research were present.

Certainly the most exciting and important discussion was that concerning the disintegration of uranium of mass 239 into two particles, each of whose mass is approximately half of the mother atom, with the release of 200,000,000 electron-volts of energy per disintegration. The production of barium by the neutron bombardment of uranium was discovered by Hahn and Strassmann at the Kaiser-Wilhelm Institute in Berlin about two months ago. The interpretation of these chemical experiments as meaning an actual breaking-up of the uranium nucleus into two lighter nuclei of approximately half the mass of uranium was suggested by Frisch of Copenhagen together with Miss Meitner, Professor Hahn's long-time partner, who is now in Stockholm. They also suggested a search for the expected 100,000,000-volt recoiling particles which would result from such a process. Professors Bohr and Rosenfeld had arrived from Copenhagen the week previous with this news, and observation of the expected high-energy particles was independently announced by Copenhagen, Columbia, Johns Hopkins and the Carnegie Institution shortly after the close of the conference. Professors Bohr and Fermi discussed the excitation energy and probability of transition from a normal state of the uranium nucleus to the split state. The two opposing forces, that is, a coulomb-like force tending to split the nucleus and a surface tension-like force tending to hold the "liquid-drop" nucleus together, are nearly equal, and a small excitation of the proper type causes the disintegration.

An interesting connection between nuclear physics and low temperatures, as pointed out by Professor Teller, is the fact that the balance between zero-point energy and potential energy is very similar in the liquid-droplet model of the atomic nucleus and in liquid helium-II. In fact, a similarity-transformation of linear dimensions by $1/10^5$ and energies by 10^{10}, in accordance with experiment, will transform the model of liquid helium-II into something very similar to the liquid-droplet model of the nucleus.

Professor Uhlenbeck introduced the discussion of the differences in the physical properties of the isotopic modification of hydrogen, H_2, HD and D_2 at low temperatures with a consideration of how these differences arise. Classical physics would lead one to expect that the equilibrium properties, that is, properties which do not involve the time explicitly, as for example, vapor-pressures and molecular volumes, should be independent of the molecular weight if the interatomic forces of atoms of H and D are alike. These forces for isotopic atoms are so nearly the same that it has been concluded that the differences in these equilibrium-properties of the isotopes must be the result of quantum-effects. Two essentially different quantum-effects arise. The first arises because the de Broglie wave-length of a gas molecule depends upon its molecular weight and at low temperatures becomes so large compared with the size of the molecule that the diffraction-effects of the de Broglie waves upon collision of gas molecules become important. This has an important bearing upon the equation of state of the gas and the differences between the virial coefficients of H_2 and D_2 may be accounted for upon this basis. The second class of quantum-effects arises because of the large differences between the zero-point lattice-energies. These are responsible for the large differences in the vapor-pressures, molecular volumes, triple points and heat-capacities of H_2, HD and D_2. Calculations based upon simple harmonic oscillators and the simple considerations of Debye's theory of the solid state have been able to account quantitatively for the observed differences in the properties. Professor London gave an account of the theoretical considerations of Mr. Hobbs and himself based upon a similarity of the intermolecular-force fields and high zero-point energies in condensed hydrogen and helium. Thus the hydrogen molecules are in effect contained in small volumes having a large confining force at the boundaries but only small forces in the interior. Calculations of the heats of vaporization of the solids and molecular volumes at 0° K are in agreement with the experimentally derived values. The anomalous character of the heat-capacities of the solid and liquid isotopes were discussed.

The differences in the properties of the ortho and para varieties of H_2 and D_2 were discussed. Dr. Karl Cohen, of Columbia University, outlined a theory developed by Professor H. C. Urey and himself to account for the larger heats of vaporization and smaller molecular volumes of the rotating ($j = 1$) varieties of H_2 and D_2. These differences in the properties of the ortho and para varieties arise because of the rotation of the ortho molecule. One important effect is that the centrifugal force resulting from the rotation stretches the inter-atomic distance in the molecule and in effect makes the rotating molecule larger.

Professor F. London, of the Institut Henri Poincaré of the University of Paris, who has been visiting professor at Duke University for some months, recently developed a theory which accounts for many of the phenomena observed in liquid helium at and below the "λ" transition point. As is well known, the phenomenon is such that the liquid helium does not become a solid upon lowering its temperature but, after passing through the λ point (sudden change of specific heat at 2.2 K), it becomes a superfluid having extremely low viscosity, a high heat-conductivity in the region of the λ point and other very strange effects such as the "fountain-effect" and an astounding ability to "creep" up the walls of containers and tubes are observed. London has proposed that this behavior is a condensation of the Bose-Einstein gas into the lowest energy-states. However, the liquid helium is not an ideal Bose-Einstein gas, since the effect of Van-der-Waals forces is to create some spatial order. This will give a decrease in the density of the levels for the lowest states (proportional to say k^4dk instead of k^2dk as for free particles, where k is the wave-number). It can be shown that such a non-ideal Bose-Einstein gas will have a jump in the specific-heat curve at the point where particles begin entering the lowest energy states. Professor London emphasized a possible analogy of the behavior of helium-II to the superconductivity-electrons in metals and to the diamagnetism observed in many types of solids. He also proposed a theory for the viscosity and heat-conduction of helium-II (bearing an analogy with electrons in a metal) which makes use of free particles obeying a Bose statistics. The work of L. Tisza on these phenomena was discussed; Tisza states that not all the atoms enter the lowest energy state and therefore a few of them have a finite momentum and exert a pressure. Only these few give rise to the viscosity which one observes; the heat-conduction arises from the change in pressure of these excited atoms. Professor Fermi and Professor London proposed several experiments which would throw further light on these problems.

Recent considerations bearing on the method of Giauque and Debye for obtaining temperatures below 1° K by the adiabatic demagnetization of a paramagnetic salt and the property of matter at these temperatures were discussed by Professor J. H. Van Vleck, of Harvard University. The well-known method of liquefying a gas such as helium consists in isothermally compressing (thus lowering the entropy of the system) and then expanding adiabatically (thus lowering the temperature while the entropy stays constant); magnetic cooling is quite similar—the magnet is the "entropy squeezer" and the field is released after establishing thermal insulation (pumping out the heat-transfer gas around the paramagnetic salt).

The experiments of Simon, Kurti and coworkers on $NH_4Fe(SO_4)_2 \cdot 12H_2O$ at temperatures below 1° K was discussed by Dr. M. H. Hebb and Dr. C. F. Squire. The absolute temperature scale was established in these experiments *not* by use of Curie's law relating the magnetic susceptibility with the temperature, but through the thermodynamic relationship $T_{abs} = \Delta Q/\Delta S$. The Curie law, which is valid at temperatures of 1° K, is no longer valid at the temperatures obtained by magnetic cooling because just the interaction forces which produce the cooling effect are responsible for the variation from Curie's law. Professor Van Vleck discussed the theory of these interaction forces—the splitting of electron-energy states by the crystalline electric field and the spin-spin interaction of the paramagnetic ions causing further splitting. Partition-functions and specific heats were calculated for several salts, and agreement with experiment indicates that a representation of the local field acting on the spins of the type proposed by Onsager is better than the classical one of Lorentz. Spin-spin interaction could only be partially solved and agreement with experiments remains only qualitative. The theoretical interpretation of the ferromagnetism (hysteresis effects) found in iron-alum by Simon and Kurti at 0.034 K remains quite unclear.

The theory of paramagnetic relaxation-time and the experiments of Professor Gorter and other Dutch physicists were discussed in great detail. Just as one has absorption and dispersion of the electric vector light, so one can have magnetic absorption and dispersion at about radio frequencies. The oscillators are the electron-spins, which are damped by the spin-spin coupling in about 10^{9}/sec; the damping-time can be enormously increased by applying an external magnetic field. Under these conditions the spin-spin coupling is too weak to "finance a turn over" of the dipoles, but the spin-lattice interaction can turn them over.

The time required for spin-lattice interaction to establish thermal equilibrium has great significance, since it might be the limiting factor in reaching still lower temperatures than have been attained up to now. According to Van Vleck and Kronig, non-adiabatic coupling between lattice vibrations and electronic motion determines this time. Quantitative calculations are still in a preliminary stage. Relaxation-time between nuclear-spin moments and electron-spins or with the lattice are very long and the cooling to extremely low temperatures by this interaction would require at least a day before equilibrium would be established. Professor Teller discussed the calculation for the time-effect. The matrix-element (perturbation-energy) which gives the transition-probability between the nuclear spin and electron-spin is quite small for paramagnetic salts. Perhaps the interaction with electrons in metals would be sufficient to cut down the relaxation-time considerably.

The theory of superconductivity was briefly discussed by Professor F. London. It must be emphasized that the magnetic behavior is as important as the superconduction. The microscopic picture is not yet clear. From the behavior of liquid helium and that of diamagnetism in solids it is probable that superconductivity is a cooperative phenomenon causing very low level-densities for low energies.

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REPORTS

THE BANTING RESEARCH FOUNDATION

THE annual report for 1937–38 of the Banting Research Foundation reveals that its income was, as usual, disbursed in two ways. A substantial part of it was placed at the disposal of Sir Frederick Banting to employ research workers in the Department of Medical Research, University of Toronto, to pursue research work of his election. This is allowing the investigation of twenty-one different problems in the department which Sir Frederick heads. The second, and slightly larger portion of the foundation's income, was widely distributed throughout Canada to twenty-four applicants who submitted problems to the foundation which met with the trustees' approval. These problems are being worked out in various hospitals and university laboratories scattered throughout the country. Analysis of the applications showed that they were granted to provide financial assistance for four different purposes: (1) salaries for full-time work, (2) salaries for part-time work, (3) salaries for helpers or assistants and (4) money for equipment and materials only. Following is a list of these workers whose applications were granted during the past year, the place where the work is being carried out and the general topic with which each problem is concerned.

B. F. Crocker, department of biochemistry, University of Toronto, is making an experimental study of digestion. E. W. McHenry, school of hygiene, University of Toronto, is studying the physiological action of vitamin C. R. W. Begg, department of pathology, Dalhousie University, Halifax, is making an extensive study of the sedimentation of erythrocytes. E. M. Boyd, department of pharmacology, Queen's University, Kingston, is pursuing further studies on the water-balance hormone of the pituitary. Maria Sergeyeva, department of physiology, McGill University, is investigating the nervous and hormone effects on the structure of islet cells. B. Rose, University Medical Clinic, Royal Victoria Hospital, Montreal, is studying the effect of cortin and histaminase on the disappearance of histamine in the adrenalectomized rat. M. J. Miller, University of Saskatchewan, is determining the distribution of human parasites in midwestern Canada. G. L. Bateman, department of physiology, Queen's University, is investigating the occurrence and function of acetylcholine in the placentae of animals. E. A. Ryan, department of biochemistry, University of Toronto, is investigating the physiological significance and chemical structure of a new compound, probably related to the sterols, which is excreted by normal humans. A. D. Odell, department of biochemistry, University of Toronto, is attempting to synthesize the progestational hormone or a possible substitute for it by the chemical degradation of an easily procurable bile acid. C. H. Walton, faculty of medicine, University of Manitoba, is, with Dr. M. Dudley's help, making a thorough pollen survey of Manitoba. K. W. Baldwin, department of anatomy, University of Toronto, is studying with A. W. Ham the fate of alveolar epithelium as the lung passes through various stages of embryonic development. D. W. G. Murray, department of surgery, University of Toronto, is continuing clinical studies regarding the effects of heparin on patients. H. T. Malloy, Royal Victoria Hospital, Montreal, is studying congenital haemolytic jaundice in the rat and man. H. B. Collier, department of biochemistry, University of Toronto, is pursuing researches on the enzymatic synthesis of protein. W. J. Auger, Hospital for Sick Children, Toronto, having devised a superior method for obtaining sputum from children, is studying type I pneumonia. D. L. Selby and R. W. I. Urquhart, both of the department of pathological chemistry, University of Toronto, are continuing their studies of experimental nephrosis, using an ingenious technique which they have recently described. E. E. Kuitunen, school of hygiene, University of Toronto, is making a survey of the distribution and type of intestinal parasites in Toronto children. D. G. MacDonald, school of hygiene, University of Toronto, is studying, in cooperation with Dr. A. A. Fletcher, the action of the B vitamins on intestinal tonus and also the cause of bradycardia, which occurs in B_1 deficiency. B. Schachter, department of biochemistry, University of Toronto, is investigating the nature of a compound in pregnant mare's urine to see if it is an oestrogen derivative. M. M. Hoffman, Dalhousie University, Halifax, is determining the physiological properties of an unidentified ketone in pregnant mare's urine. P. G. Weil, University Clinic, Royal Victoria Hospital, Montreal, is pursuing biochemical studies on the metabolism of progesterone, investigating the sterol metabolism in the toxemias of pregnancy, and studying a new sterol, with reference to the adrenal cortex.

The trustees were pleased to note that medical literature of last year contained over thirty reports of research carried out with the assistance of the Banting Research Foundation. The indication many of these reports gave to the effect that medical science is slowly making inroads upon some of man's most stubborn ills, should, in the opinion of the trustees, be a source of satisfaction to those who showed their appreciation of Sir Frederick Banting's researches by endowing a foundation to allow him and others to continue to advance the state of medical knowledge.

V. E. Henderson,
A. W. Ham,
Honorary Secretaries

SPECIAL ARTICLES

THE OCCURRENCE OF GAMMA TOCOPHEROL IN CORN EMBRYO OIL[1]

Olcott and Emerson[2] showed that the tocopherols have strong antioxidant powers, and concluded that they represent at least a large part of the antioxidants in wheat-germ and cotton-seed oils. There seems to be no relation between the vitamin and antioxidant activities of these substances, since alpha, which is the most potent as the vitamin, is the weakest antioxidant. Gamma, which is approximately equal in vitamin potency to beta, is definitely a more powerful antioxidant.

It seemed interesting to determine if the antioxidant properties of other vegetable oils might be due to the presence of tocopherols, and those oils with less vitamin potency might contain the less vitamin-potent beta or gamma. Accordingly we investigated corn oil, since Mattill and Crawford[3] had shown it to be rich in antioxidants.

Freshly pressed, unrefined corn oil[4] was assayed for vitamin E. A single dose of 4 gm enabled all four test rats to cast good litters, but at 2 gm only resorptions resulted. Three kilograms of the oil was saponified, the non-saponifiable fraction distributed between high boiling petroleum ether and 92 per cent. methanol, and then dry methanol, and the methanol solution was concentrated, chilled to free it as much as possible of sterols, and finally the oily residue distilled in a molecular still, as previously described for palm oil[5]. The fraction distilling between 120–140°, which contained the bulk of the vitamin, weighed 5.65 gm. Fed at a level of 15 mg, three resorptions and one litter resulted, but at 45 mg all four rats fed had litters. Karrer and Keller[6] measured by titration with gold chloride the tocopherol content of a non-saponifiable fraction of corn oil, freed from most of the sterols, and found it to be 0.2 per cent. Assuming the critical level of gamma tocopherol to be 6 mg, Karrer and Keller's measurement would appear to be in reasonable agreement with the results of our feeding tests.

The concentrate was treated with cyanic acid in benzene, as previously described. The only tocopherol which could be isolated was gamma, whose allophanate, mp. 137–140°, gave no depression on admixture with gamma tocopheryl allophanate previously obtained from cotton-seed oil. The yield was about 700 mg.

The allophanate was saponified, and the free tocopherol fed at levels of 3 to 6 mg. Of four rats fed 3 mg one had a litter and three resorbed, while of five rats receiving 6 mg, two had litters and three resorbed.

The gamma allophanate, on admixture with beta allophanate, mp 143–6°, melted at 130–5°. This, together with the complete difference in the habit and appearance of the two allophanates, would seem to leave little reason to doubt their non-identity. On the other hand, the admixture of alpha tocopheryl allophanate mp 158–60° lowers the melting point of gamma only two or three degrees, which makes it very difficult to be certain that a preparation of gamma is not contaminated with alpha. However, the absence of any considerable amounts of alpha from corn oil greatly facilitates the preparation of gamma in a comparatively pure form.

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[1] Aided by grants from the Department of Agriculture, University of California and by Merck and Company, Inc., Rahway, N. J. Assistance was rendered by the Works Progress Administration, Project No. 10482 A-5.

[2] H. S. Olcott and O. H. Emerson, *Jour. Am. Chem. Soc.*, 59: 1008, 1937.

[3] H. A. Mattill and Blanche Crawford, *Jour. Ind. Eng. Chem.*, 22: 341, 1930.

[4] The corn oil was kindly supplied by the Miner Millard Milling Co., Wilkes-Barre, Pa.

[5] O. H. Emerson, G. A. Emerson, Ali Mohammad and H. M. Evans, *Jour. Biol. Chem.*, 122: 99, 1937.

[6] P. Karrer and H. Keller, *Helv. Chim. Acta*, 21: 1161, 1938.

THE QUANTITATIVE DETERMINATION OF VITAMIN C IN MILK

Recent studies[1, 2, 3, 4] have shown that there are a number of important factors which may influence the results obtained in the determination of vitamin C in milk by titration with 2,6-dichlorobenzenoneindophenol. Such variables as temperature, light, method of standardizing the dye (2,6-dichlorobenzenoneindophenol), stability of the dye, contact of the milk with oxygen, catalytic elements present and methods of precipitating milk protein have been outstanding in these reports.

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[1] P. F. Sharp, *Jour. Dairy Science*, 21: 85, 1938.

[2] S. K. Kon and M. B. Watson, *Jour. Soc. Chem. Ind.*, 55: 508, 1936.

The present work was undertaken to simplify and to make reproducible a quantitative procedure for determining the total amount of vitamin C in milk as it comes from the dairy cow.

Kon and Watson[5] have shown that ascorbic acid (vitamin C) in milk as it leaves the cow's teat is in the reduced form. In this form the vitamin C content of milk may be determined quantitatively by direct titration with 2,6-dichlorobenzenoneindophenol. Should the milk, however, in the process of collection, be exposed even very briefly to contact with air, catalytic metals, light or heat, an unavoidable loss of ascorbic acid occurs due to oxidation. In order to eliminate the effect of these factors in collecting samples directly from cows of the college herd, a special apparatus was devised (See Fig. 1).

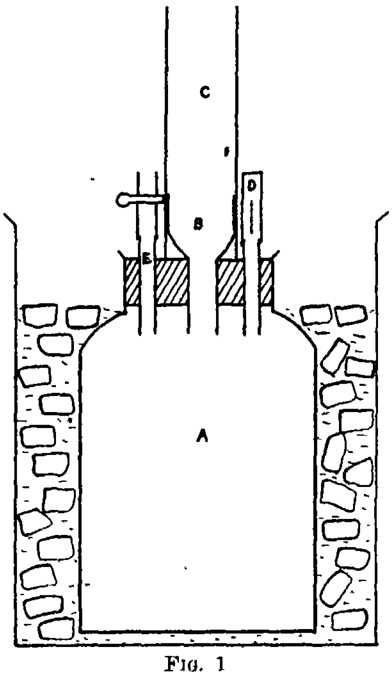

FIG. 1

A 500 ml dark-glass bottle (A) was placed inside a 2-liter beaker and surrounded with ice and water. This was done a short time prior to milking in order that the bottle might become thoroughly chilled. The bottle was fitted with a 3-holed rubber stopper. Through one hole of this stopper projected a glass adapter (B) having a funnel stem. A dark rubber tube (C), thin enough to be quite pliable and about one inch in diameter, was stretched over the adapter and pulled down to the rubber stopper. The upper part of this tube extended about three inches above the top of the adapter and was the part which was slipped over the teat of the cow during milking. A tube fitted with a Bunsen valve (D) passed through another hole in the stopper. Another glass tube (E) passed through the third hole and was provided with a short length of rubber tubing so that it could be closed off with a pinch clamp. The size of this tube was such as to permit the insertion of a 10 ml bulb pipette for removal of samples. Before milking, the air in the dark bottle was expelled through the Bunsen valve by closing all outlets with pinch clamps and flushing with carbon dioxide from a pressure tank.

To determine if the ascorbic acid of milk obtained in the above apparatus was completely in the reduced form, two samples were removed and titrated immediately, while other samples were subjected to treatment with hydrogen sulfide and then titrated after removing excess hydrogen sulfide with carbon dioxide. Typical results are given in Tables 1 and 2.

TABLE 1
TITRATION OF UNTREATED MILK SAMPLES

Ml milk	Ml dye	Mg ascorbic acid per aliquot	Mg ascorbic acid per liter
10.00	1.90	0.2280	22.80
10.00	1.91	0.2292	22.92
		Average .. 0.2286	22.86

TABLE 2
TITRATION OF HYDROGEN SULFIDE TREATED SAMPLES

Ml milk	Ml dye	Length of treatment in minutes	Mg ascorbic acid per aliquot	Mg ascorbic acid per liter
10.00	1.91	10	0.2292	22.92
10.00	1.91	10	0.2292	22.92
			Average 0.2292	22.92
10.00	1.92	30	0.2304	23.04
10.00	1.91	30	0.2292	22.92
			Average 0.2298	22.98
10.00	1.91	100	0.2292	22.92

The instability of 2,6-dichlorobenzenoneindophenol solutions reported by some workers was satisfactorily overcome by preliminary extraction of the dye with anhydrous ethyl ether. Solutions of dye, thus purified, and standardized according to the methods of Menaker and Guerrant,[6] remained perfectly stable and gave sharp end points over a period of 21 days.

Metaphosphoric acid was found by Fujita and

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[3] R. R. Musulin and C. G. King, *Jour. Biol. Chem.*, 116: 409, 1936.

[4] C. H. Whitnah, W. H. Riddell and W. J. Caulfield, *Jour. Dairy Science*, 19: 373, 1936.

[5] S. K. Kon and M. B. Watson, *Biochem. Jour.*, 31: 223, 1937.

[6] M. H. Menaker and N. B. Guerrant, *Jour. Ind. Eng. Chem.*, Anal. Ed., 10: 25, 1938.

Iwatake,[7] Lyman, Schultze and King[8] and others to protect vitamin C in solution against oxidation. This property, combined with the protein-precipitating ability of metaphosphoric acid, was made use of in the present work in preparing milk samples for titration. To eliminate the uncertain protein-precipitating power encountered with ordinary metaphosphoric acid solutions, the required volume of a stable sodium metaphosphate solution, prepared by the method of Briggs,[9] was acidified just before each titration and added to the milk. Using 10 ml of 10 per cent. sodium metaphosphate solution, the addition of 0.6 ml of concentrated hydrochloric acid was found to bring the pH of the solution to a point (pH 2.5–3.0) where immediate and complete flocculation of protein resulted upon addition of the metaphosphate solution to 10 ml of milk.

Titrations were made in the presence of precipitated milk protein. By repeated centrifuging and washing of the milk protein followed by separate titrations of combined centrifugate and protein residue, it was found that slightly higher ascorbic acid values were obtained in titrations of milk in the presence of precipitated protein. However, upon the addition of pure ascorbic acid to the protein residues and repetition of the centrifuging procedures and titrations, it was shown that the slightly higher apparent values obtained in the presence of milk protein were due to adsorption of negatively charged dye by positively charged protein. No adsorption of ascorbic acid by the milk protein could be demonstrated.

The new apparatus and improved technique provides a simple but reliable method of obtaining and determining vitamin C of milk in its naturally occurring form. The improvements mentioned should be of value in following fluctuations of vitamin C in milk at different stages of lactation, at various seasons of the years, during feeding experiments and under numerous other conditions.

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A PLANT GROWTH INHIBITOR

During the course of physiological investigations on the plant hormone relationships in radish, strain French Breakfast, an ether extraction was made of 4.935 grams fresh weight of cotyledons from seven-day-old seedlings. These plants had been grown in the open in rich, loamy soil. The extraction was carried out according to the simplified auxin extraction method of Van Overbeek.[1] On testing the extract by the Avena test (Went and Thimann[2]) positive curvatures of from 17 to 23 degrees were found instead of the usual negative ones. (If the substance being tested is growth-promoting then the Avena plant will grow more rapidly on the side on which the substance is applied. Thus, because of this unsymmetrical growth, the plant will become curved in a direction away from the side on which the substance is applied. This is known as a negative curvature. If, however, the material causes an inhibition of growth then the plant will likewise grow unsymmetrically, but now the resulting curvature will be in a direction toward the side of application of the substance. This is known as a positive curvature.)

The relation between the concentration of the extract and degrees of positive curvature was investigated. In determining the amount of positive curvature 48 Avena plants were used at each dilution value. The inhibitor, extracted as above, was taken up in 1½ per cent. agar and cut into blocks 1.6 × 2 × 2 mm for application to the test plants. The standard Avena technique for auxin determination was used except that the curvature—positive in this case—was measured 150 minutes after applying the inhibitor instead of after 90 minutes, as is customary when testing growth-promoting substances. The results are seen in Fig. 1.

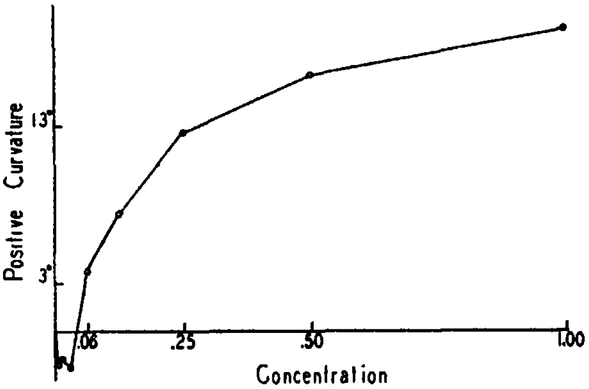

Fig. 1. Relation between positive curvature of Avena plants and two-fold dilutions of inhibitor substance.

This graph shows that positive curvatures between 3 to 13 degrees are proportional to the concentration of the inhibitor.

Using the method given by Schneider and Went[3] a Photokymograph test was made of the reaction time of the coleoptile to growth inhibitor. The results are pre-

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[7] A. Fujita and D. Iwatake, *Biochem. Zeits.*, 277: 293, 1935.

[8] C. M. Lyman, M. O. Schultze and C. G. King, *Jour. Biol. Chem.*, 118: 757, 1937.

[9] D. Briggs, *Proc. Soc. Exp. Biol. and Med.*, 37: 634, 1938.

[1] J. Van Overbeek, *Proc. Nat. Acad. Sci.*, 24: 42, 1938.

[2] F. W. Went and K. V. Thimann, "Phytohormones," Macmillan Company, New York, 1937.

[3] C. L. Schneider and F. W. Went, *Bot. Gaz.*, 99: 470, 1938.

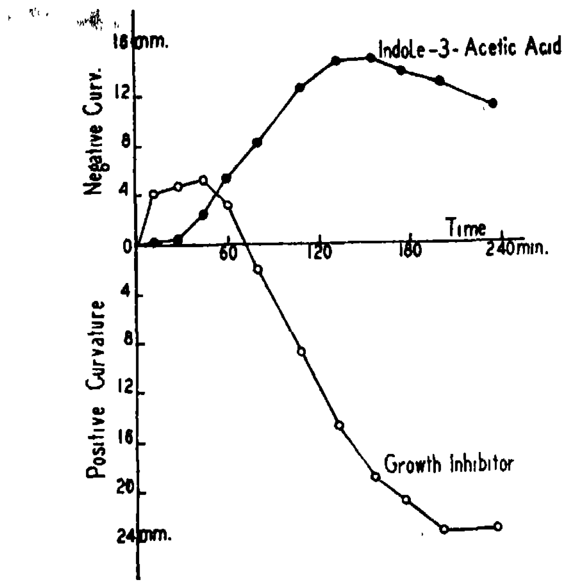

FIG. 2. Curvature rate of Avena plants upon application of: (*a*) .05 mg/liter, indole-3-acetic acid, and (*b*) growth inhibitor. (Ordinate values given as mm deviation of the extended coleoptile from the vertical position.)

sented in Fig. 2. It is observed that a negative curvature is initiated which rapidly changes between the first and second hour to a positive curvature, reaching its maximum three hours after the application of the inhibitor. It is interesting to note that the reaction rate for this negative curvature is different from the negative curvature caused by auxin. This is shown by the control run made at the same time as the inhibitor test but by using a growth-promoting substance, indole-3-acetic acid, .05 mg per liter. Each point on the graph is the average of twelve Avena test plants.

Inhibitor was found in the cotyledons of radish plants grown in the light or dark, but it was not found in the hypocotyl in either case.

The inhibitor substance is of neutral character. Accordingly as one would expect on the basis of Went's[4] potential gradient theory of auxin transport, it should be transported acropetally as well as basipetally. Experiments prove this to be the case, as was shown by equal amounts of inhibitor passing through normal and inverted 4 mm long sections of Avena coleoptiles. Similar experiments show there is likewise no inhibitor transport polarity in radish hypocotyl sections.

In conclusion, it may be said that the positive curvatures resulting from the application of the inhibitor are not to be considered the same as the positive curvatures resulting from the retardation of the physiological tip regeneration in the Avena coleoptile because these are usually of slight magnitude, and furthermore they are never preceded by a negative curvature during the first hour.

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[4] F. W. Went, *Jahrb. wiss. Bot.*, 76: 582, 1932.

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ELIHU THOMSON[1]

ELIHU THOMSON'S INTEREST IN RESEARCH

To treat this subject comprehensively would be to write a complete biography of Professor Thomson, for research, both in its broadest sense of a search for knowledge and in its narrower sense of systematic experimentation, was the major interest of his life.

As a young boy we find him studying industrial processes, both mechanical and chemical. At the age of ten or eleven he was constructing small cupola furnaces and attempting to make iron castings. Prepared for high school two years before he reached the required age for entry, and urged to give up his books for a while, he weepingly protested that life would not be worth living if he had to discontinue his studies. He employed the two-year interval in school work in building static machines, Leyden jars, condensers, etc., and was continually making experiments, some of which, as he recognized later, were worthy of publication as original matter. Chemical knowledge he was simultaneously pursuing, through books and by experiment.

Throughout his high-school years he was always "constructing things," but it was after graduation, when at the age of seventeen, he became assistant professor and, two or three years later, full professor of chemistry, that his marvelously productive career as a scientist truly began. It was during this period from the age of seventeen to twenty-seven that he published his first original papers (on chemical subjects); experimented with electromagnetic waves, foreshadowing radio, and produced the first "tuned" circuit; accomplished telephone relaying; studied the fundamentals of dynamo-electric machines and established new and basic principles; suggested high voltage d-c transmission; advanced the novel but now accepted theory of relation between sun-spots, magnetic storms and auroras; studied hysteresis, and advanced precociously the electrical theory of matter; built and studied transformers, and experimented with electric energy distribution by their means; and somehow found leisure to construct a pipe organ and a microscope, fashioning all parts of these with his own hands. In later years he constructed with his own hands a telescope with 10-inch diameter objective, and used it constantly in astronomical studies.

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[1] Papers presented at a meeting in commemoration of the life and work of Elihu Thomson under the auspices of the American Philosophical Society, the Franklin Institute of Pennsylvania, the Central High School of Philadelphia, the Massachusetts Institute of Technology and the General Electric Company, held in the halls of the American Philosophical Society and the Franklin Institute on February 16.

When, in 1880, he gave up teaching, to devote himself to the commercial development of his ideas and to the building up of the great electrical industry which owes so much to him, he soon found that the urgent need for inventions and engineering design was engrossing nearly all his time, leaving small opportunity for scientific research. But he never lost his keen interest in science. In its literature he closely followed its progress, and often contributed to it by original suggestions.

To show the variety of his interests, I might mention the following diverse subjects which he studied and on which he contributed original papers: very high frequency currents, and their effects on the human body; x-rays, their diffusion, their effect on human tissue, their use in stereoscopic pictures; lightning hazards; aeroplanes; electric welding; the meteorite which fell in Canyon Diabolo, and the use of helium mixed with oxygen to prevent "bends" in caisson workers.

In 1899, as vice-president of the American Association for the Advancement of Science, he read a paper on "The Field of Experimental Research," and, the next year, took an active part in instituting the Research Laboratory of the General Electric Company. That laboratory was unique in industry in having for its primary purpose fundamental research. While the written record indicates that the laboratory was first proposed by E. W. Rice, Jr., then vice-president of the company, and while it was certainly founded by his authority, yet it is equally certain that Mr. Rice's keen interest in research in pure science arose from his long and close association with Professor Thomson, first as pupil and then as assistant. There can be no doubt but that Professor Thomson was the father of scientific research in the General Electric Company.

For years he was a most helpful and inspiring member of the advisory council of the laboratory, keenly interested in all details of its work and frequently helping by wise and timely suggestions. From his broad knowledge and experience he often could throw new light on our problems, and his resourcefulness seemed never-failing in suggesting methods of attack. To all of us in the laboratory his enthusiasm and keen mentality were always an inspiration. His wise counsel and hearty support were invaluable to us in the laboratory's early years.

In his later life, when he had relinquished all direct responsibility for engineering activities of the company, he was again able, in his Lynn laboratory, to return to his first and deepest interest—research. It was then that he did his classic work on fused quartz, producing a quartz mirror 60 inches in diameter for a telescope. A visit to him there was always delightful and stimulating. Always would he be found with some new experiment, new material or new idea, which he would eagerly discuss with his characteristic friendly smile and sparkling eyes. Even when failing health forbade active work, his old keen interest in science remained and stayed with him to the end.

A cultured gentleman, a lovely character, a great inventor, a most able engineer, he was also a gifted scientist, and truly the father of General Electric research.

W. D. Coolidge

Research Laboratory of the
General Electric Company
Schenectady, N. Y.

ELIHU THOMSON THE SCIENTIST

Nearly a decade ago, in reviewing Elihu Thomson's productive life, I wrote: "More than any man now living . . . Professor Thomson has combined in a most remarkable way the constructive power of the inventor, the thoroughness and soundness of the man of science, and the kindly balance of the ideal philosopher, teacher, and friend." Now that Professor Thomson is no longer with us, I still abide by that appraisal; and in again reviewing his contributions and characteristics, this time with emphasis on his talents as a scientist, I find added reasons to support this judgment.

There are scientists who dwell in ivory towers remote from the Rialto, and it is well that they do if it is there that they can be most productive; and there are scientists no less important to the world who elect to practice the scientific method for the realization of practical ends, and it is well that they do, for science must take its place in the workaday world.

The ivory tower scientist seeks primarily, we might say, to understand nature, while the applied scientist, whom we usually call an engineer, seeks to control nature. This distinction has been concisely stated by our distinguished colleague, Dr. Gano Dunn. "Engineering," says he, "is the art of the economic application of science to social purposes . . . the scientist . . . shuts his mind as far as possible to all human prejudice and influence of feeling, save only for the divine fire of that imagination which creates the working hypothesis; and he learns to discern truth and new knowledge in a study of the order of nature. The engineer, by the same intellectual processes as the scientist, applies that new knowledge to social service."

It was a notable characteristic of Professor Thomson that he embodied both these types of science in a manner that makes it almost impossible to distinguish between them. He sought ardently to understand nature, and he was enormously successful in controlling nature. He possessed the divine fire of that imagination which creates the working hypothesis, and he applied knowledge engineeringwise to social purposes. Obviously, then, in discussing Thomson the scientist as distinct from Thomson the engineer, I make a circumscription of convenience, not of reality, a distinction that does an injustice to the unity of his outlook and achievement.

Who would venture to maintain, for example, that it was Thomson the inventor and electrical engineer and not Thomson the scientist who discovered the dynamical repulsion between a primary and a secondary coil? Since this discovery was used by him in developing the alternating current repulsion motor it certainly was a triumph in electrical engineering, but nevertheless it was a notable scientific achievement. This is likewise true of his investigation of the laws governing the electric arc, of his building the first high-frequency dynamo and the first high-frequency transformer and of his invention of electric resistance welding. Since Professor Thomson's inventive and engineering achievements are discussed by my colleague on this program, I merely call attention to much excellent scientific work as the accompaniment, and often the precursor, of his practical triumphs.

Within the amplitude of his activity, however, there were many examples of achievement and method bearing the hallmarks of fundamental, non-utilitarian science, such hallmarks as disinterested curiosity, reliance on experiment and intuitive grasp of scientific relationships. Let me recall several of these.

In 1875 Edison announced a new "etheric" force which he described as non-electrical. Professor Thomson, then only twenty-two years of age, doubted this, and, as he himself wrote:

> I had proposed to Houston that we carry on these experiments and show definitely that the so-called ''etheric'' force that Edison had announced in the papers was merely an electrical phenomenon. At this time I took upon myself the enlargement of the scale of the experiments, so as actually to obtain a very definite result. This was carried out, as follows, in 1875. A 6-inch spark Ruhmkorff coil was set up with one terminal connected by a wire about 5 feet long to a large tin vessel mounted on a glass jar on the lecture table. When the coil was in operation, sparks were allowed to jump across the terminals of the coil itself, these sparks being about 1½ inches to 2 inches long and having the character of condenser sparks. When the coil was in action, I explored the whole building throughout the several floors and then went up to the top of the building to the observatory, where Professor Snyder had charge of the astronomical instruments. It was found that tiny sparks could be obtained from metal objects wherever they were, in the cases or outside, from the door-knobs or from apparatus, by the simple expedient of shading from the light and detecting the tiny sparks with a pointed pencil by applying it, say, to the door-knob. I recognized clearly that this was a manifestation of electric waves passed through space, and I also understood that a system of communication might readily be based thereon.

With the exception of Joseph Henry's experiments, which were unpublished, here was the first experimental demonstration of the validity of Maxwell's theory, and here, too, was an example of Professor Thomson's extraordinary intuition anticipating the wireless transmission of signals twelve years before Hertz demonstrated electromagnetic waves and twenty odd years before Marconi received his patent on "telegraphy without wires."

This was one of the earliest experiments in a long series of investigations of high-frequency electrical phenomena. Only a year later in 1876, he discovered and was the first to use the method of tuning electric circuits, which is, of course, absolutely fundamental to modern communication systems. While working in this field he devised a way of producing high frequency alternating current from a direct current arc, by shunting the arc with inductance and capacity, thus discovering the method which played such an important role in wireless transmission until its virtual displacement by electronic tube devices. Because this method was actually applied to radio by Poulsen it is generally known as the Poulsen arc.

Among the many other results of his basic high-frequency discoveries is modern electrosurgery, which Dr. Harvey Cushing put into effective use.

This was but one of several contributions to medical science. After Röntgen announced his discovery of x-rays in 1895 Professor Thomson immediately began a series of experiments with them, the foundation for which had been laid by his previous experiments, beginning in 1891, on electric discharge through gases. In 1897 he made the first application of stereoscopic principles to x-rays, a great step forward in the medical use of x-rays for clinical purposes. He also made many improvements in the design of x-ray tubes, including the double-focus tube and a cooled-target tube. Along with these experiments he took a lively interest in the physiological effects of x-rays, going so far as to expose one of his fingers until a definite burn resulted.

In addition to electricity, two other branches of physics, optics and acoustics, commanded Professor Thomson's interest. In 1878 he published an account of a new method of grinding and polishing glass mirrors such as are used in telescopes. He later originated many ingenious tools for the working of optical glass, and as a hobby built for his own home observatory a ten-inch achromatic telescope. This interest in optics was of course related to his life-long interest in astronomy. A bibliography of his astronomical studies and observations contains a score of items, including discussions of Aurora's "cosmical electricity," meteor flight, zodiacal light, comets and solar eclipses. Acoustics, like optics and astronomy, was a fruitful scientific hobby, and deserves mention as evidence of Professor Thomson's wide range of scientific activities. He even constructed a pipe organ, and played it with great pleasure. Another avocation pursued with scientific ardor was color photography.

Still other scientific byways of Professor Thomson's interest were the earth sciences. He published on "The Nature and Origin of Volcanic Heat," and in his last appearance before the American Academy of Arts and Sciences in 1933 he read a paper on "The Krakatoa Outbreak." The eruption of this volcano in Java occurred when he was a small boy in Philadelphia, and had incited the curiosity which he always exhibited. He had watched for evidences, in the brilliant sunsets, of the volcanic ash in the upper atmosphere and had, I am informed, recorded his observations. At a much later date he hired as a research assistant the sole survivor of the catastrophe and induced him to record his personal observations of the event. In his paper before the academy he reported on this record, upon the history of the eruption and upon his own boyhood observations of its effects.

While the major portion of Professor Thomson's scientific research was in the field of physics and he usually referred to himself as a physicist, he was an able chemist as well; in fact, he began his professional career as a teacher of chemistry in the Central High School in Philadelphia. In recently examining his contributions to chemistry, I found that *Chemical Abstracts* in the twenty-year period beginning in 1907 listed two dozen papers of his relating to chemistry. In the first year after his graduation he reported observations on color changes produced by heat in chemical compounds, and in 1873 he contributed to the *Philadelphia Medical Times* a paper on the "Inhalation of Nitrous Oxide, Nitrogen, Hydrogen and other Gases and Gaseous Mixtures," thus foreshadowing his suggestion forty-seven years later that helium-oxygen mixtures be used in deep-sea diving. He early observed the transformation of ordinary carbon into graphite, and in 1902 disclosed his pioneer work in fused quartz, a field in which he was again working at the end of his life. In the nineties he published three papers on the possibilities of liquid air, in 1906 an article with the modern-sounding title "Alcohol as a Motor Fuel," and in 1910 comments on the light of the firefly. In chemistry, as well as in physics, he demonstrated an intuitive insight into nature that testifies to his profound gifts as a scientist.

It is laboring the obvious to recite further Professor Thomson's scientific accomplishments. I turn, rather, to some of his more intangible achievements and to the scientific ideals which he exemplified.

Behind all his varied scientific activities, stood a man who had complete faith in the efficacy of the scientific method and who in all his activities, vocational and avocational, was the apotheosis of the scientific spirit. Something of his own view of his methods was incorporated in an address delivered by him in 1899 as vice-president and chairman of the physics section of the American Association for the Advancement of Science, in which he said:

> The development in the field of research by experiment is like the opening of a mine, which, as it deepens and widens, continually yields new treasure but with increased difficulty, except when a rich vein is struck and worked for a time. In general, however, as the work progresses there will be needed closer application and more refined methods. In most fields of research the investigator must be ready to guide the trained mechanic and be able himself to administer those finishing touches which often mark the difference between success and failure. There must be in his mental equipment that clear comprehension of the proper adjustment of means to ends which is of such great value in work in new fields. He must also learn to render available to science the resources of the larger workshops and industrial establishments. . . . Scientific facts are of little value in themselves. Their significance has a bearing upon other facts, enabling us to generalize and to discover principles, just as the accurate measurement of the position of a star may be without value in itself, but in relation to other similar measurements of other stars may become the means of discovering their proper motion. We refine our instruments, we render more trustworthy our means of observation, we extend our range of experimental inquiry and thus lay the foundation for future work with the full knowledge that although our researches can not extend beyond certain limits, the field itself is even within those limits inexhaustible.

Observation and experimental inquiry were his chief reliances; he apparently did not resort to the analytical methods that most scientists and engineers use who tackle problems as complex as he solved. Perhaps the answer lies in that intuition which I have mentioned; Professor Thomson did not need to employ mathematical analysis because his mind leapt to correct conclusions without it.

His powers of observation he carried into every walk of life, and no one could be with him for ten minutes without being impressed and stimulated by his perception and by his wide-ranging knowledge of natural phenomena. Perhaps he could best be described by saying that he was a brilliant natural philosopher who was held in equally high esteem by practical engineers and by academic scientists.

Perhaps the most eloquent testimony to his scientific contributions may be found in the wide-spread appreciation to-day of the value of research in industry. Professor Thomson was one of the first in America to recognize the importance of research, both fundamental and practical, to our industrial progress. This was a contribution that transcended any of his scientific discoveries.

His sense of public responsibility is illustrated by his long reluctance to patent his system, developed in 1878, of distributing alternating current by transformers, because of the possible danger to the public. It was not until he discovered a way to avoid the danger, chiefly by grounding the secondary in the transformer, that he filed his patent in 1885. The patent on this safety device was dedicated to the public from a feeling that no patent or invention which has to do with public safety should in any way be restricted or made unavailable to the people.

That he cherished the title "Professor" was indication of his unabated interest in education. He never ceased to teach. "Throughout his life," wrote my predecessor and his friend, Dr. Richard C. Maclaurin, president of M.I.T. from 1909 to 1920, "he has not only done great things himself, but shown an intense desire to help all who are struggling earnestly with scientific problems. He has proved an inspiration to an ever-widening circle of engineers and others who have intrusted him with their secrets and sought his help in overcoming their difficulties. They have done this, knowing that they had only to ask in order to get the full benefit of his imagination and his power, and that they need have no misgivings that he would take any advantage of their confidence or any credit for their work, for he has no touch of selfishness."

From my own knowledge of Professor Thomson I can validate Dr. Maclaurin's tribute.

His long association with M. I. T. affords a specific example of his devotion to education. He became a lecturer in electrical engineering at this institution in 1894, and from then until his death he maintained with it the closest sort of relationship. He was elected a life member of the corporation in 1898, was acting president in 1920 to 1923, and for many years was a member of the executive committee of the corporation. His services to the institute alone place him among those who have contributed greatly to American science.

If we add to this his services to the Franklin Institute, to the American Philosophical Society, to the American Academy of Arts and Sciences, to the National Academy of Sciences and to a host of other institutions, we get some measure of his influence and constructive contributions to the scientific profession.

For these and many other reasons it is meet to pay tribute to Professor Thomson as a distinguished scientist, and I do so with affection and enthusiasm. Not only were his scientific contributions numerous and important, but he consistently served science by being an ideal connecting link between the practical and the theoretical, the industrial and the academic. By his vigor, perseverance and versatility he contributed one of the most brilliant chapters yet written in the book of American science.

KARL T. COMPTON

MASSACHUSETTS INSTITUTE
OF TECHNOLOGY

OBITUARY

WILLIAM McDOUGALL

WITH the death of William McDougall on November 28, 1938, the science of psychology lost one of its foremost creators. The range of his contributions prohibits detailed review here. Fortunately he himself has given an unusually penetrating interpretation of his life and work.[1]

The prolonged preparatory studies of McDougall foreshadow the wide scope of his later work. He was born in Lancashire on June 22, 1871. After a year at Weimar, he entered Manchester University (1886). Feeling forcibly the impact of the controversy over evolution, he read widely in biology and worked also in geology and paleontology. He won a scholarship at Cambridge and took the premedical course there, specializing in physiology, anatomy, anthropology (1890–94). Drawn toward problems of the nervous system, he completed the medical course at St. Thomas Hospital, London, ending as house physician (1894–98).

In reading William James he had become increasingly aware of the possibilities of the psychological approach to the problems of human nature. During the next two years he came into first-hand contact with primitive cultures (participation in the Cambridge Anthropological Expedition to the Torres Straits; collaboration in Borneo with C. Hose); and studied the newer laboratory methods of German experimental psychology (with G. E. Müller at Göttingen). To this extensive background was later added four years of study and treatment of "shell-shocked" soldiers.

The external features of McDougall's professional career did not bear a very intimate relation to his creative work, and may be stated briefly: At first, reader in experimental psychology at University College, London (1900–04); later Wilde reader in mental philosophy at Oxford (1904–20); during the war, major in the Royal Army Medical Corps; then professor of psychology at Harvard (1920–27); finally professor and head of the department of psychology at Duke University (1927–38). His academic degrees and honors include the following: Cambridge University, M.B., and Fellow, St. John's College (1898); Oxford University, A.M. (1908), and Fellow, Corpus Christi College (1912); University of Manchester, Honorary Sc.D. (1919); Fellow, Royal Society of London (1912); Honorary Fellow, St. John's College, Cambridge (1938).

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[1] "A History of Psychology in Autobiography," I. Edited by C. Murchison. Worcester: Clark University Press, 1930, pp. 191–223.

McDougall's psychological activity was of a varied character formally: he was systematist, acute empirical observer, clinician, experimentalist. In addition to his intensive early experiments in the psychophysiology of vision, he has published experimental work on auditory perception, memory, mental fatigue, drug effects, animal behavior, evolutionary theory. Unfortunately, most of the voluminous clinical notes made during the four years of war work with shell-shocked soldiers remain unpublished.

Although occupied at first more with their physiological correlations and later with their social aspects, McDougall attempted from the beginning to develop a system of concepts in terms of which the whole range of mental events might be interrelated. Accepting as fundamental the directed, purposive features of behavior and their evolutionary development, he developed a biological conception of fundamental urge systems. Behavior in all its complexities was interpreted as an expression of their action and conflict at different levels of organization. This conception was differentiated in its detailed application to problems in the fields of animal and human behavior, normal, abnormal, primitive, social.

McDougall was the most fundamentally biological of all psychologists, and his stress on heredity and eugenics bore major experimental fruit. Typical of his views as to the possible contributions of psychology to biology was his sustained experimental test, during the last seventeen years of his life, of the Lamarckian theory. For, if substantiated, it would provide an essentially psychological explanation of the dynamics of the evolutionary process itself. Significant also was his elaboration of the implications of psychology for the related social sciences and for philosophy.[2]

In this country McDougall, the man, was unfortunately known well by relatively few of his fellow psychologists. His deep family attachments are revealed in his own writings. To each of his departmental colleagues he was a personal friend, and his department was run intellectually and administratively in a spirit of absolute democracy. Characteristic to the end were his vigor, keenness, flexibility, open-mindedness. Always bold in his thinking and insatiably curious concerning every type of mental phenomenon, he believed that study at the fringes of psychology (as in psychic research) would yield valuable further insights into human nature. His great courage and strength of character were brought into relief during his last months. Very weak, and suffering from a painful cancer, he wrote the final chapter of his last book lying on his back, and, until physically unable, walked to the laboratory to run final control trials in his Lamarckian experiment.

An evaluation of McDougall's psychology in relation to current trends would be premature. Similar answers to many of the problems he discussed are being approximated by others, though often in other terms. His own terminology seems not to have readily suggested functional tests for its own further refinement. Any scientist must be viewed against the contemporary background of his own science. So considered, McDougall was unique in breadth of view and variety of contribution. During a period of psychology characterized by perhaps premature specialization and a tendency to turn toward the problems of other fields, McDougall performed the great service of facing steadily the vast range of phenomena which in the broadest sense are the concern of the *psychologist,* of pointing in masterful fashion to their essential features and of showing how in terms of his comprehensive set of concepts, their interrelationship might, to a first approximation, be understood. When highly satisfactory answers to all the problems with which he wrestled have been finally formulated psychology will have become a science indeed, and the goal of a great mind achieved.

KARL ZENER

DUKE UNIVERSITY

RECENT DEATHS AND MEMORIALS

ADMIRAL RALPH EARLE, U.S.N., retired, president of Worcester Polytechnic Institute since 1925, died suddenly on February 13 at the age of sixty-five years.

FRANK DEAN TUBBS, who was professor of geology at Bates College, Lewiston, Me., from 1907 to 1929, died on February 23 at the age of seventy-four years.

A CABLE from Bermuda to *The New York Times* dated February 21 reports that on February 20 Dr. Alfred George Jacques, of the Rockefeller Institute for Medical Research, was drowned, and Dr. Marie Lebour, of the Marine Biological Laboratory at Plymouth, England, had a narrow escape when the dinghy in which they were dredging for specimens upset. Dr. Jacques, who was in his forty-third year, was unable to swim. Dr. Lebour, who is now seventy years old, was able to keep afloat until rescued.

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[2] A bibliography of McDougall's work, appearing in *Character and Personality,* March, 1939, lists 147 titles of articles and books.

The death is announced of Professor S. P. L. Sörensen, director of the chemical department of the Carlsberg Laboratory at the University of Copenhagen, at the age of seventy-one years.

Professor Karl Schröter, emeritus professor of botany in the Federal College of Technology, Zurich, has died at the age of eighty-four years.

It is stated in *Nature* that the British Minister of Health has approved an order made by Slough Town Council under the Town and Country Planning Act, 1932, for the preservation of Observatory House, Slough, the residence of Sir William Herschel, where he set up his 40-ft. telescope, and also of his son, Sir John Herschel.

A ceremony in commemoration of the biologist and physician, Lazzaro Spallanzani (1729–1799) will be held at Padua next spring during the meeting of the International Congress of Experimental Biology.

SCIENTIFIC EVENTS

THE PUBLIC WORKS ADMINISTRATION AND THE NATIONAL PARK SERVICE

Work on the eighty-nine PWA projects for physical improvements in the national parks and monuments, from PWA allotments amounting to $2,090,500, which were announced in 1938, was under way before January 1. Ranging from allotments for $500 to $230,000 for one project, most of the work involves improvements to utilities, including sanitation facilities, water systems, lighting and power plants in the various areas of the Federal park system. In Yosemite National Park, California, there are ten miscellaneous projects that will be carried out at a cost of $200,600.

At Lassen Volcanic National Park, California, five projects are in progress involving a total expenditure of $76,500. One at Carlsbad Caverns, New Mexico, involves the installation of modern plumbing facilities in the caverns, 750 feet below the surface. This entails pumping raw sewage to the surface, requiring a special type pump—a problem seldom experienced by sanitary engineers.

At Lava Beds National Monument, California, a well will be drilled 900 feet through a lava cap in an effort to find water. The water has now to be hauled some distance in tanks and barrels. At Petrified Forest National Monument, Arizona, a pump house and new pipe line will be installed to increase its fresh water supply obtained from a well at "Pig River" twelve miles away. A well drilled at Petrified Forest several years ago produced only salt water.

Some of the larger projects undertaken in the national parks and monuments are:

> At Grand Canyon National Park, Arizona, a schoolhouse and teacher's residence together with schoolroom equipment, to cost $35,000; Giant Forest, in Sequoia National Park, California, an improved water system to cost $36,000; modern water and sewage systems at Rocky Mountain National Park, Colorado, $42,000; an extension to the storage reservoir at Mesa Verde National Park, Colorado, $35,000.
>
> Boulder Dam Recreational Area, Nevada, will have increased facilities at the Hemenway Wash area being developed on the shore of Lake Mead. These will include water, sewage, electricity and an irrigation system. This project will cost $150,000.
>
> Olympic National Park, Washington, will get an administration building, custodian's home, warehouse and garage on land donated to the Federal Government by the city of Port Angeles, Washington. A new fire lookout tower, fire patrol cabins and trailside shelters will be provided. The projects for this park will cost $90,000, with an additional $25,000 for the extension and reconstruction of the telephone and radio systems, and $90.500 for miscellaneous trail construction.
>
> In Yellowstone National Park, Wyoming, $230,000 will be spent for improvement and extension of the water, sewage and electric systems for Old Faithful, West Thumb, Fishing Bridge and Canyon. An additional $12,500 are expected to go on five secondary fire lookouts.
>
> An allotment of $45,000 for the Statue of Liberty National Monument, New York, will permit the replacing of an old six-inch water main from the tip of Manhattan Island to Bedloe's Island.

Most of the other projects involve relatively small sums, and have to do with sewage, water, sanitary facilities and similar improvements. The Salem Maritime National Historic Site, Massachusetts, will have its separate and inadequate heating plants replaced by a new central plant in the old custom house, to serve Derby House and Hawkes House.

THE DEDICATION OF THE McDONALD OBSERVATORY

The ceremonies attending the dedication of the McDonald Observatory at Fort Davis, Texas, to be held from May 5 to 8, will be conducted jointly by the University of Chicago and the University of Texas. On this occasion an astronomical symposium will be held under the auspices of the observatory and of the Warner and Swasey Company, under the general title "Galactic and Extragalactic Structure." Those wishing to attend the dedication and the symposium are requested to make hotel reservations by writing to the Observatory, Fort Davis, Texas.

The Southwestern Division of the American Association for the Advancement of Science will hold its annual meeting at Alpine, Texas, from May 2 to 5, immediately preceding the dedication ceremony. On Thursday evening, May 4, Professor Arthur H. Compton will deliver the annual John Wesley Powell Lecture of the Southwestern Division on "Physics Views the Future." On Thursday morning and afternoon the sessions of the Section on Physical Sciences will be reserved for astronomical papers. Contributions to this program are invited from all observatories. Titles should be sent to Dr. C. T. Elvey, McDonald Observatory, Fort Davis, Texas, before April 1.

On Friday morning there will be an astronomical symposium at the McDonald Observatory at which the presiding officer will be Professor Henry Norris Russell, director of the Princeton University Observatory. The speakers will be Professor Harlow Shapley, of the Harvard College Observatory; Dr. J. Gallo, of the National Observatory of Mexico, and Dr. J. S. Plaskett, director emeritus of the Dominion Astrophysical Observatory.

The program at the dedication on Friday afternoon of the McDonald Observatory will be as follows:

Tender of completed observatory to the director by President P. E. Bliss, of the Warner and Swasey Company.
Acceptance of the completed observatory by Professor Otto Struve, Yerkes Observatory.
''The Cooperative Enterprise,'' President Robert Maynard Hutchins, of the University of Chicago.
Acceptance for the University of Texas by a member of the Board of Regents.
''Some Features of the New Mirror,'' Dr. J. S. Plaskett, director emeritus of the Dominion Astrophysical Observatory.
''The First of the Sciences,'' Professor Arthur H. Compton, University of Chicago.
Dedication of the observatory, President J. W. Calhoun, of the University of Texas.

On Saturday there will be a symposium on "Galactic Structure." In the morning Professor S. A. Mitchell, of the McCormick Observatory, will preside, and Dr. J. H. Oort, of the Leiden Observatory, and Dr. R. J. Trumpler, of the University of California, will take part. In the afternoon the presiding officer will be Professor H. G. Gale, of the University of Chicago, and the speakers will be Dr. Otto Struve, of the Yerkes Observatory; Dr. Bart J. Bok, of the Harvard College Observatory; Dr. C. T. Elvey, of the McDonald Observatory, and Dr. G. P. Kuiper, of the Yerkes Observatory. Dr. E. A. Milne, of the University of Oxford, will speak on "Cosmological Theories" at the evening session, over which Dr. Edwin Hubble, of the Mount Wilson Observatory, will preside.

A further symposium on "Galactic and Extragalactic Structure" will be held on Sunday presided over in the morning by Professor E. F. Carpenter, of the Steward Observatory, with Dr. Walter Baade, of the Mount Wilson Observatory, and Professor Harlow Shapley, of the Harvard College Observatory, as speakers. In the afternoon Dr. W. S. Adams, of the Mount Wilson Observatory; Dr. Cecilia Payne Gaposchkin, of the Harvard College Observatory; Dr. W. W. Morgan, Yerkes Observatory; Dr. Bertil Lindblad, Stockholm Observatory and Morrison research associate at the Lick Observatory, and Dr. S. Chandrasekhar, of the Yerkes Observatory, will take part in the discussion. In the evening Dr. Arthur H. Compton, of the University of Chicago, will preside, and Dr. Edwin Hubble, the Mount Wilson Observatory, will be the speaker. In the final session on Monday morning Dr. W. H. Wright, of the Lick Observatory, will be the presiding officer, and the speakers will be Dr. Joel Stebbins, of Washburn Observatory, and Professor Henry Norris Russell, of Princeton University Observatory.

AWARD OF THE HILLEBRAND PRIZE OF THE CHEMICAL SOCIETY OF WASHINGTON

THE Hillebrand Prize of the Chemical Society of Washington, for 1938, has been awarded to Raleigh Gilchrist and Edward Wichers, of the National Bureau of Standards, for their paper entitled "A New System of Analytical Chemistry for the Platinum Metals," presented before the ninth International Congress of Pure and Applied Chemistry at Madrid.

The work represents the first general advance in the analytical chemistry of the platinum group since Deville and Stas devised methods for the analysis of the platinum alloys used in fabricating the international prototype meter and kilogram, over sixty years ago. The new system enables the chemist to separate and determine these six closely related metals with a degree of accuracy equal to that of the more exact procedures used for the common metals.

Related procedures applied to refining have resulted in the preparation of the platinum metals in an exceptionally high degree of purity. These pure metals and some of their alloys are used to establish certain important standards based on natural constants, such as freezing points in the upper range of the temperature scale, standards of radiation, of electrical resistance and of thermal electromotive force.

The prize will be awarded at the annual dinner of the society, which will be held at the Cosmos Club on March 9.

AWARD OF THE WILLARD GIBBS MEDAL TO DR. VAN SLYKE

THE Willard Gibbs Medal of the Chicago Section of the American Chemical Society has been awarded for 1939 to Dr. Donald Dexter Van Slyke, research chemist of the Rockefeller Institute for Medical Research, New York City, in recognition of his work on the chemistry of proteins, enzyme action blood chemistry and the metabolic conditions of diabetes and nephritis. In announcing the award the jury gave the following summary of the work for which it was made:

> By showing that fatal diabetic coma is preceded by a falling off in the bicarbonate content of blood plasma, Dr. Van Slyke made it possible to anticipate and prevent the sudden onset of coma. Such bicarbonate determination is now in general application in hospitals.
>
> In Bright's disease and renal physiology, he has worked out methods of measurement of renal function, established the relation of renal function to renal disease, and found some explanation for chemical changes in the blood and in metabolism.
>
> The mystery surrounding the mechanism of enzyme action he solved by showing that enzymes act by forming with substrates the substances acted upon by enzymes, definite compounds in which the substrate becomes unstable and undergoes decomposition. In the physical chemistry of gases and electrolytes of the blood he showed the law governing the solubility of the blood gases—oxygen, carbon dioxide, nitrogen, carbon monoxide and hydrogen—in blood fluid and cells.
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> In the physiology of amino acids, Dr. Van Slyke has followed through the animal body the course of such acids from digesting proteins, proving that they pass into the blood and thence into all tissues, but chiefly into the liver, and that the change to urea nitrogen occurs chiefly in the liver.
>
> In the chemistry of amino acids he has developed methods for quantitative separation, methods for determining aliphatic primary amino nitrogen and analysis which have become standard, and analysis of proteins by determining the characteristic chemical groups of amino acids resulting from hydrolysis.
>
> The speed and accuracy of gasometric micro methods of analysis worked out by Dr. Van Slyke have led to their introduction into general analytical microchemistry. These methods are in routine use for ammonia, organic nitrogen, organic carbon, calcium, iodate, chloride, ferricyanide and reducing sugars.
>
> Determination of proteins combined with alkali in the cells and in the fluid of the blood showed that the differences in non-diffusible protein ions combined with alkali within and without the cells were such as to clear up, under the Gibbs-Donnan theory for heterogeneous equilibria, the puzzling situation which arose from the fact that the concentration of certain chemicals is not the same in blood fluid and blood cells. These differences were found to vary regularly with increasing pH and with increasing oxygenation of the hemoglobin.
>
> Dr. Van Slyke introduced a unit now generally adopted for expressing quantitatively the power of "buffers," substances which can loosely combine with alkali and surrender it to strong acids, to set free in their place only acids that are relatively weak and innocuous. By this unit, the activity of the buffer solution is related to pH and the dissociation constant of the buffer acid or base.

The award was determined by a national jury of scientific men, of which Professor Charles D. Hurd, of Northwestern University, was chairman. Dr. Robert R. Williams, of New York, discoverer of the chemical structure of vitamin B, was the medalist in 1938. Other medalists were: Svante Arrhenius, of Sweden; Mme. Marie Curie, of France; Sir James Irvine, of Scotland; Dr. Richard Willstaetter, of Munich. Among American scientific men have been Theodore W. Richards, Leo H. Baekeland, Ira Remsen, Arthur A. Noyes, Willis R. Whitney, Edward W. Morley, William H. Burton, William A. Noyes, F. G. Cottrell, Julius Stieglitz, Gilbert N. Lewis, Moses Gomberg, John Jacob Abel, William D. Harkins, Claude S. Hudson, Irving Langmuir, Phoebus A. Levene, Edward C. Franklin, Harold C. Urey, Charles A. Kraus, Roger Adams and Herbert N. McCoy.

SCIENTIFIC NOTES AND NEWS

DANIEL W. MEAD, consulting engineer of New York City, a former president of the American Society of Civil Engineers, was presented with the Washington Award for 1939 of the Western Society of Engineers at a dinner held in Chicago on February 20.

DR. ALEXANDER WETMORE, assistant secretary of the Smithsonian Institution, has been elected an honorary member of the Sociedad Cubana de Historia Natural Felipe Poey.

DR. FRANK SCHLESINGER, director of the Observatory of Yale University, has been elected a member of the Royal Society of Sciences of Upsala.

DR. ALFRED HARKER, fellow of St. John's College and reader in petrology emeritus in the University of Cambridge, celebrated his eightieth birthday on February 9.

SIR HENRY HALLETT DALE, director of the National Institute for Medical Research, and Dr. Arthur Lyon Bowley, emeritus professor of statistics in the University of London, have been elected honorary fellows of Trinity College, Cambridge.

THE University of Oxford will confer the degree of doctor of science on Dr. Pio del Rio Hortega, director of the National Institute of Cancer and of the Laboratory of Normal and pathological Histology in Madrid, in recognition of his "valuable discoveries, arising out of the employment of new and original methods in connection with the anatomy of the brain."

THE British Institution of Chemical Engineers has awarded the Osborne Reynolds Medal, presented annually in commemoration of Professor Osborne Reynolds, to Hugh Beaver for "valuable constructive work." The Moulton Medal, presented annually in commemoration of Lord Moulton, director-general of Explosives Supply in the Ministry of Munitions during the war, has been awarded jointly to Dr. J. H. Dobson and Dr. W. J. Walker, professor of engineering in the University of the Witwatersrand, Johannesburg, for their work on engineering problems associated with the improvement of conditions in mines. The Junior Moulton Medal has been awarded to E. F. J. Tomalin, who has recently left King's College, London, for the Dutch West Indies to work in the petroleum industry, and the William Macnab Medal to Pierre Etienne Rousseau, of Johannesburg, a mining engineer.

IT is announced in *Nature* that the Academy of Sciences in Vienna has made the following awards: The Haitinger prize for physics to Dr. H. Haberlandt, for his work on the luminescence of fluorites and other minerals; the Rudolf Wegscheider prize for chemistry to Dr. R. Kuhn, for his work on lactoflavine; the Fritz Pregl prize for microchemistry to Dr. F. Hecht, for his work on microchemical analysis, particularly of thorium, monazite and uranium minerals; the Hansgirg prize for astronomy to Dr. M. Beyer, for his work on the photometry of stars, and in particular for his work on variable stars.

F. MALCOLM FARMER, vice-president and chief engineer of the Electrical Testing Laboratories, New York City, has been nominated for the presidency of the American Institute of Electrical Engineers.

DR. F. G. DONNAN, professor of chemistry in the University of London, has been elected to succeed Sir F. Gowland Hopkins as president of the Association of Scientific Workers.

OFFICERS of the Royal Astronomical Society, London, have been elected as follows: *President,* Professor H. C. Plummer; *Vice-presidents,* Professor S. Chapman, W. M. H. Greaves, Dr. H. Spencer Jones and Professor F. J. M. Stratton; *Treasurer,* J. H. Reynolds; *Secretaries,* Professor H. H. Plaskett and D. H. Sadler; *Foreign Secretary,* Sir Arthur Eddington.

SIR JAMES JEANS, the mathematical physicist, who was professor of applied mathematics at Princeton University from 1905 to 1909, has accepted an invitation to become the Conservative candidate for Parliament from the University of Cambridge at the next general election.

DR. HERBERT S. JENNINGS, of the Johns Hopkins University, has been appointed professor of zoology for the spring semester at the University of California at Los Angeles.

PROFESSOR OTTO NEUGEBAUER, of the University of Copenhagen, has accepted an appointment as professor of mathematics at Brown University, where he will be engaged in research until May. During the summer he will lecture in England, and will return to Providence in September.

DR. JAMES COULL, professor of chemical engineering of Cooper Union, New York City, a native of Aberdeen, Scotland, has been appointed professor and head of the department of chemical engineering at the University of Pittsburgh, to succeed Professor Harrison C. Bashioum, who died last October. He will take up the work at once.

E. H. PRAEGER, of New York City, for the last several years chief engineer for Madigan-Hyland, consulting engineers for Park Commissioner Robert Moses of New York, has been named head of the department of civil engineering at the Rensselaer Polytechnic Institute. He succeeds Professor Thomas R. Lawson, who will retire at the end of the year after serving for forty years as a member of the faculty, as head of the department since 1921.

DR. RICHARD PRAGER, of Potsdam, Germany, until recently of the University of Berlin, arrived in Boston on February 26 to join the research staff of the Harvard College Observatory. He will be at Harvard for at least two years, taking up research work on variable stars. Dr. Prager, who was stationed until recently at the Berlin-Babelsberg Observatory, is known as bibliographer in the field of variable stars and for many years was chiefly responsible for naming variable stars and for recording them in the annual catalogue.

DR. JAMES RÖGNVALD LEARMONTH, Regius professor of surgery at the University of Aberdeen, has been appointed professor of surgery at Edinburgh University to succeed the late Sir David Wilkie.

DR. L. WITTGENSTEIN, formerly fellow of Trinity College, has been elected professor of philosophy at the University of Cambridge, to succeed Dr. G. E. Moore, who will retire at the end of the current academic year.

DR. FRANK H. JOHNSON, instructor in biology at Princeton University, has been awarded a fellowship by the Rockefeller Foundation in order to carry on work in microbiology in the laboratory of Professor A. J. Kluyver, at the Technische Hoogeschool, Delft, Holland. Dr. Johnson will spend six months in Professor Kluyver's laboratory, returning to Princeton next autumn.

DR. BENEDICT CASSEN has joined the staff of the Westinghouse Research Laboratories in East Pittsburgh, Pennsylvania, to conduct research on means of producing high voltage x-rays for therapeutic uses. He has been engaged in x-ray and neutron research at the Harper Memorial Hospital in Detroit.

DR. ALBERT RAY OLPIN has been appointed to succeed the late Hurlbut S. Jacoby as research director of the Ohio State University Research Foundation.

JAMES STOKLEY, associate director in charge of astronomy in the Franklin Institute of Philadelphia, has been appointed director of the new Buhl Planetarium and Institute of Popular Science in Pittsburgh. The Board of Managers of the Franklin Institute has accepted his resignation, effective on April 15. The Buhl Institute is being erected by the Buhl Foundation, at a cost of $1,070,000. The building, now nearing completion, is situated on the north side of the city on a site furnished by the municipality, which was formerly occupied by the old Allegheny City Hall. In addition to a Zeiss planetarium, fifth in the United States, and a public observatory, the building will include a lecture hall seating 250 persons, a main exhibit hall 150 feet long by 33 feet wide, five smaller halls, a room for amateur telescope makers, offices, shops and preparation rooms.

DR. WARREN J. MEAD, head of the department of geology of the Massachusetts Institute of Technology, delivered the February lecture before the Rensselaer Chapter of the Society of Sigma Xi. The March lecture will be delivered by Dr. Brian O'Brien, of the University of Rochester. His subject will be "Detection and Consequences of the Variability of the Sun."

PROFESSOR A. K. LOBECK, of the department of geology of Columbia University, recently returned from a tour of several southern universities, where he gave lectures on Russia, including one before the LeConte Scientific Society of the University of South Carolina.

DR. FRANCIS CARTER WOOD, director of the Institute of Cancer Research at Columbia University, gave the Bergen lecture at Yale University on February 1. He spoke on "Cancer—Social and Scientific Aspects."

APPLICATIONS for the positions of senior mineral economist, at $4,600 a year; mineral economist, at $3,800 a year; associate mineral economist, at $3,200 a year, and assistant mineral economist, at $2,600 a year, must be on file with the U. S. Civil Service Commission at Washington, D. C., not later than March 13. Competitors will not be required to report for examination at any place, but will be rated on the extent of their education and on the extent and quality of their experience and fitness which are relevant to the duties of the position.

ORGANIZATION of a committee of physicians and laymen to aid Yale University in the development of its program in medicine and public health was announced by Dean S. Bayne-Jones, of the School of Medicine, at a meeting of medical alumni held in the Sterling Hall of Medicine on February 23. Dr. Harvey Cushing, Sterling professor of neurology emeritus and director of studies in the history of medicine, will act as general chairman, with an executive committee composed of Dean S. Bayne-Jones, *chairman;* Fuller F. Barnes, Bristol, Conn.; William McCormick Blair, Chicago; George Parmly Day, Yale University; Thomas W. Farnam, Yale University; Dr. Norman E. Freeman, Philadelphia; Harry C. Knight, New Haven; Dr. Fred T. Murphy, Detroit; Professor C.-E. A. Winslow, Yale University, and Dr. Milton C. Winternitz, Yale University. The purpose of the committee is to aid in making better known among the alumni and friends of the university the work of Yale in medicine and public health. For the development of this work, large sums, contingent upon the receipt of further gifts, have already been pledged.

MEMBERS of a state soil conservation committee authorized at the last special session of the California State Legislature have been appointed as follows: Dean Claude B. Hutchison, of the College of Agriculture; Professor B. H. Crocheron, director of the Agricultural Extension Service, University of California, and Edward Hyatt, state engineer. Walter W. Weir, university drainage engineer, has been made secretary. It is understood that the membership of the university men on the committee is purely advisory, and that the actual administration and operation of the act will remain in the hands of the state officials. The committee is empowered to promote the formation of soil conservation districts, to investigate proposed soil conservation districts, to advise with such districts, to cooperate with the appropriate federal authorities and with individuals and corporations interested in soil conservation and to coordinate the activities of the various agencies interested in soil conservation.

THE ninth semi-annual Eastern Photoelasticity Conference will be held at Cornell University on May 13. The committee on local arrangements, of which Professor F. G. Switzer, of the College of Engineering at Cornell, is chairman, expects an attendance of approximately one hundred scientific workers in this field, both from college faculties and from the research staffs of various industries. The program of technical papers will be supplemented by an exhibit of the latest equipment for photoelastic research and demonstrations in the laboratories. A special program is being prepared for the wives of those who attend the conference.

DISCUSSION

WILLIAM BREWSTER: NEW ENGLAND NATURALIST

THE natural history of New England can not be found in any one book, and in many ways I am glad that it is so. For I think I shall always want to go to "Moby Dick" for cetacean lore; to "Walden" for such natural philosophy as may be educed from bean-fields, ponds and winter animals; to Frank Bolles's stanzas for vivid glimpses of Chocorua's wild tenants; to Forbush's "Birds of Massachusetts" for precise ornithology; and to other works equally unique.

There are some classic accounts of New England's nature that date back to colonial times. For an early first-hand record of the now extinct heath-hen of Martha's Vineyard, one may go to Thomas Morton's "New English Canaan" (1637), and to John Josselyn's "New England's Rarities Discovered" (1672) for an authoritative glimpse of that noble bird, the wild turkey, which for us has become an emblematic part of colonial New England, but which disappeared from Connecticut in 1813, from Vermont about 1842 and from Massachusetts in 1851.

New England, indeed, has had its share of illustrious naturalists. Perhaps one thinks first of Thoreau, the Concord hermit, and then of the great teacher and scientist, Louis Agassiz, who, though not a native son, was for many years (beginning in 1848) associated with Harvard College, and it was he who established a museum of zoological research at Harvard, now the Museum of Comparative Zoology.

Years later there worked at this same museum a man in whom was happily combined the indoor and the outdoor naturalist. His name was William Brewster, and he was one of the greatest of American ornithologists. He was a Yankee birdman unique in at least one respect: "No ornithologist has ever lived in America who could compare with Brewster as a master of simple, dignified English prose"—this on the authority of Dr. Thomas Barbour, the present director of Harvard's Museum.

During his lifetime Brewster was little known outside of his own profession. But it happened that during a great part of his life, which extended from 1851 to 1919, he kept voluminous diaries, which were full of bird lore and of Concord River lore, and out of these diaries have come three books, published posthumously, that are bringing Brewster's genius to the attention of the general reader to parallel the high esteem in which ornithologists have held him for many years. His technical bibliography is a long one, but I believe he would have been particularly gratified at the way his three last volumes have been received. His friend Daniel Chester French, the sculptor, remarked that Brewster "always regretted that he could not write popular articles on natural history as did some of his contemporaries."

"The Birds of the Lake Umbagog Region of Maine" is the first of these works to be mentioned. It is a 620-page volume, issued in four parts as a *Bulletin* of the Museum of Comparative Zoology: the first in June, 1924, the second in February, 1925, the third in November, 1937, and the fourth (compiled by Ludlow Griscom) in February, 1938. It represents field observations and collecting of birds around Lake Umbagog over a period of 38 years, beginning in 1871, when Brewster was only 20 years of age. It is all original work; there is scarcely a quotation in it. A great deal of it is supplemented by extracts from his detailed journals and notebooks written at the time the field work was in progress. But even in these there is no slipshod writing, and in every line there is evidence of the carefullest scientific observation but recorded in a way that betrays William Brewster's great love of nature and all its manifestations. It is straightforward and without sensationalism. On August 24, 1874, for example, he writes:

> Wearing a purple-and-yellow cardigan jacket, recently obtained from a country store in Upton, I was fishing this morning at a pool of Cambridge River, just below the Sluice, when a Hummingbird hovered for a moment within a few inches of the aforesaid garment, doubtless attracted by its gaudy coloring and probably suspecting that it might prove to be a bank of unfamiliar flowers. Precisely the same thing happened in another place several days ago. The bird did not fly away on either occasion until I startled it by moving slightly.

In 1891 Brewster bought an old farm of about 300 acres of woodland near Concord, about a mile and a half northwest of where the river bends around Balls Hill. This was in the old stamping grounds of Thoreau, and it was here that Brewster spent a great deal of his time studying the wild creatures and setting down the intimate details of their lives as he saw them first-hand. He fixed up the old farmhouse and named his sanctuary "October Farm."

And it was this expressive name, "October Farm," that became the title of the first volume of extracts from his Concord journals and diaries published in 1936 by the Harvard University Press and edited by his friend the late Rev. Smith Owen Dexter, of Concord. An introduction to the volume by Daniel Chester French, with whom Brewster grew up, is a real tribute, depicting the peculiar charm of William Brewster the man. Unpretentious and unheralded by publisher's ballyhoo, the book was enthusiastically received by nature lovers and by many who had never heard before of its author. It went into a second edition, and an index was added. I believe it was advertised chiefly by word of mouth, the ideal way for news of a good book to spread.

Last year (1937) the Harvard Press followed "October Farm" with another volume from the Brewster journals called "Concord River." This was illustrated by a dozen plates, some in color, by the artist Frank W. Benson, who also had been a friend of Brewster's. The American Institute of Graphic Arts selected "Concord River" as one of the "Fifty Books of the Year" in its 1938 exhibition of American bookmaking.

The great simplicity and genuineness of these books are almost unbelievable in this day and age. They are books of the earth, but not of man's world. The entry for April 16, 1912, the day after the *Titanic* sank, reads:

> I saw two Great Blue Herons flying over the Farm towards the northeast at an elevation of fully a *mile*, one following closely in the wake of the other. For the most part they flapped their wings steadily and ceaselessly but twice I saw one of them sail for the distance of a few rods on set wings.

The same day he noted a flock of 36 Canada geese flying so high that they appeared no larger than bluebirds. "Rarely have I witnessed anything of the kind so impressive." Instead of man's noisy doings, Brewster wrote of bird songs, the tracks of foxes, the beauty of snowstorms, woods smoke and his beloved river. Thomas Barbour refers to him as the "modest and peerless recorder" and "utterly impersonal." "He wrote with no 'mission' in mind but simply because he had a warm, irrepressible urge to observe nature and set forth what he had seen but not what he thought about it."

Brewster's standing as a scientist probably will rest on his many other works and technical papers on ornithology, but as New England's great outdoor naturalist it will depend largely on the diaries and journals he left, and a most generous sampling of them has been given to us in the three volumes here described.

The details of Brewster's life have been adequately recorded elsewhere,[1] and my purpose here is merely to remind naturalists everywhere of these new chapters that have been added to the rich body of New England's natural history. Perhaps I may be pardoned if I add here my sonnet called "William Brewster: Man of Concord," which appeared originally in the *Washington Post* as a "review" of the book "Concord River." I believe it tells in another way what manner of man he was and why New Englanders should be proud that he was theirs.

There by the river's bend he had his place.
New England hills and hollows, fields, and springs
Belonged to him, and he had sight and space
To see uncommonness in common things.
Up and down the Concord, paddling his canoe,
He sought out nature's secrets like a sleuth;
The flutter of a bird was oft a clue
To bring him beauty and to show him truth.

For serving God his meed was great and good:
He touched a trembling vireo; unheard
He watched a fox's cunning in the wood;
To him the robin's rapture was transferred.
How many men like Brewster do you know,
Who'd find it joy to let a weasel go?

PAUL H. OEHSER

U. S. NATIONAL MUSEUM

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[1] Sketch by Henry W. Henshaw in *The Auk*, January, 1920; and biography by Dr. Witmer Stone in the Dictionary of American Biography.

THE FERMENTATION TEST FOR THIAMIN

SCHULTZ, Atkin and Frey[1] refer to a note published in SCIENCE[2] from this laboratory and deny the implication that their fermentation test involves the *growth* of yeast. Such implication, if present in the note referred to, was erroneous. It is true, of course, that growth and fermentation can be dissociated (as has been done in the fermentation test), but on the other hand under many laboratory conditions they are closely related; so much so that the discovery of the *growth* essential "bios" by Ide[3] (Wildiers[4]) was based upon a *fermentation* test. The vitamin test of Bachman (1919) was likewise based upon fermentation (during growth). Substances which stimulate growth need not necessarily influence fermentation, but they often do so.

Our questioning of the specificity of the fermentation test for thiamin was based partly on experiments which may have involved cleavage products of the vitamin.[5] If this is so, it has been cleared up by the discoverers of the fermentation test.[6]

Other objections which are perhaps not crucial are based upon the fact that substances other than thiamin, notably pantothenic acid, and nicotinic acid (discovered to be an interference by the originators of the method),[7] have an influence. Duplicating the author's conditions as nearly as is possible using the Warburg technic, we have found that pantothenic acid, by stimulating fermentation in the presence of thiamin, may increase the carbon dioxide production 10 per cent. If deficient yeast (grown on a medium which is nearly synthetic in character) is used, the effect of pantothenic acid on fermentation (without growth) is even much greater than that of thiamin. Under these conditions, which are admittedly not those prescribed by the authors of the test, β-alanine and ethanolamine also have definite stimulative effects.

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[1] A. S. Schultz, L. Atkin and C. N. Frey, SCIENCE, 88: 547, 1938.

[2] R. J. Williams, SCIENCE, 86: 349, 1937.

[3] R. J. Williams, SCIENCE, 88: 475, 1938.

[4] E. Wildiers, "La Cellule," xviii, 313, 1901.

[5] R. J. Williams and R. R. Roehm, *Jour. Biol. Chem.*, 87: 581, 1930.

[6] A. S. Schultz, L. Atkin and C. N. Frey, *Jour. Amer. Chem. Soc.*, 60: 3084, 1938.

[7] A. S. Schultz, L. Atkin and C. N. Frey, *Jour. Amer. Chem. Soc.*, 60: 1514, 1937.

Stimulation of yeast fermentation by liver extract (Lilly's 343) is vastly greater under the conditions prescribed than can be obtained by any amount of added thiamin. Under these conditions growth accompanies the fermentation. If conditions which permit growth are carefully avoided, this difficulty is minimized.

On the basis of further developments and recent work by the originators we are now more favorably inclined to the fermentation test for thiamin than formerly. Though subject to certain errors, we believe that as amended it may serve as a very useful tool.

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ERNEST F. PRATT
OREGON STATE COLLEGE

THE INFLUENCE OF SOME DIGESTIVE FERMENTS ON THE EXPERIMENTAL CROWN-GALL

IN our experiments we tried to repeat some of the very interesting experiments described by Ark.[1] That author has found that digestive ferments such as pepsin, papain and some other organic compounds had a very marked influence on the plant tumors caused by *Pseudomonas tumefaciens.*

For these experiments we chose 30 different crown-galls on Pelargonium inoculated with *P. tumefaciens,* strain "Bela" from the Lister Institute in London. Eleven tumors were treated with papain and eleven with pepsin. Eight were kept as controls. These enzymes were applied in powdered form and were placed in long narrow incisions where small sections of tumors had been cut away. From all control tumors similar sections of tissue were taken away. Then the galls were wrapped in Cellophane.

Six out of eleven tumors treated with pepsin deteriorated, one month after treatment. Five were left without any or only slight injury. Out of eleven tumors treated with papain three died off and nine were left partly or entirely intact. From the eight control tumors four died off in the same time as treated ones.

Therefore, our findings are not in complete agreement with those of Ark. We came to the conclusion that the enzymes like papain and pepsin are not always effective in the treatment of crown-gall. In some cases at least the mechanical injury of crown-gall may effect a total necrosis of the tumors.

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[1] P. A. Ark, SCIENCE, 85: 364.

ALEPRIC AND ALEPRYLIC ACIDS, NEW HOMOLOGS OF CHAULMOOGRIC ACID

IN analyzing *Hydnocarpus wightiana* oil by the method described by us[1] the high optical activity and iodine numbers of the lower boiling fractions of ethyl esters indicated that there must be present at least one more optically active fatty acid besides those already known (chaulmoogric, hydnocarpic and gorlic[2] acids). By repeated vacuum fractional distillation of 100 liters of *H. wightiana* ethyl esters and fractional crystallization of the free acids we have finally succeeded in isolating two new homologs of chaulmoogric acid. There is still a third homolog present which we hope to obtain pure, but being a liquid acid, it is much more difficult to purify.

Because of their relationship to the therapy of leprosy we have named these two new acids alepric acid and aleprylic acid. Alepric acid is the next lower homolog to hydnocarpic acid, containing two carbon atoms and four hydrogen atoms less than the latter. The acid is solid at room temperature, melts sharply at 48° C. and has a high specific optical rotation (+77°). The melted acid, upon solidifying, forms characteristic, beautiful branching crystals rising high above the surface of the melt, similar to those already reported by us for pure chaulmoogric and hydnocarpic acids.[3]

Aleprylic acid is the next lower homolog to alepric acid, differing from it by C_2H_4. It crystallizes in the same characteristic manner as the other homologs. It melts sharply at 32° C. and has a very high specific optical rotation (+90°).

The bactericidal properties of these acids against *M. leprae* as compared with those of chaulmoogric, hydnocarpic and gorlic acids are now being determined.

The methods of separating these new acids with more detailed data concerning them and their ethyl esters will form the subject of a paper to be published elsewhere.

HOWARD I. COLE
HUMBERTO T. CARDOSO
INTERNATIONAL LEPROSY CENTER,
RIO DE JANEIRO, BRAZIL

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[1] H. I. Cole and H. T. Cardoso, *Jour. Am. Chem. Soc.,* 60: 614, 1938.

[2] *Ibid.,* 60: 612, 1938.

[3] *Ibid.,* 59: 963, 1937.

SOCIETIES AND MEETINGS

THE SOCIETY OF THE SIGMA XI

The thirty-ninth annual convention of the Society of the Sigma Xi met at 4:00 P.M. on Wednesday, December 28, in the Hotel Jefferson in Richmond, Virginia, with forty-six chapters and thirteen clubs represented by delegations of from one to three members.

In his annual report as president of the society, Professor Baitsell announced fourteen grants-in-aid totalling $3,000; the assignment of five lecturers to forty institutions all over the country; and the society's first published volume, entitled "Science in Progress," to be issued by the Yale University Press in the spring, containing the ten Sigma Xi lectures sponsored by the society in the last two years.

Four new chapters have been added to the organization during the year—Rice Institute, Wellesley College, Massachusetts State College and the University of Florida. This brings the total of chapters to seventy-six, with an active enrolment of approximately 16,000.

The treasurer's report showed permanent funds amounting to approximately $40,000, an annual expenditure of $18,000 met from current income and a surplus of income over disbursements of approximately $3,000 for 1938.

Charters for chapters were granted to the University of West Virginia and the University of Alabama.

Dr. Carl D. Anderson, of the California Institute of Technology, was elected a member of the executive committee for the ensuing five-year term to succeed Professor L. J. Stadler, whose term of office has expired. Dr. Florence Sabin, of the Rockefeller Institute, was elected a member of the Alumni Committee for the ensuing five-year term to succeed Mr. Harold Norton, whose term has expired.

A committee was appointed to study the present membership structure of Sigma Xi for report at the next convention.

An amendment to the constitution was adopted, providing for the revocation of a charter of a chapter when, and if, circumstances should demand such action.

The seventeenth annual Sigma Xi lecture, under the joint auspices of the American Association for the Advancement of Science and of Sigma Xi, was given in the Mosque by Dr. W. F. Durand on "Modern Trends in Air Transport."

Edward Ellery

FINANCIAL REPORTS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE AT THE RICHMOND MEETING

Audited financial reports of the treasurer and the permanent secretary for the fiscal year ended September 30, 1938, were presented and approved by the council. The following is a brief digest:

Treasurer's Report

Balance Sheet—Assets at September 30, 1938

Securities and mortgages	$255,205.36
Cash—income account	8,933.88
Cash—reserve for current needs	15,998.90
Total assets	$280,198.14

Balance Sheet—Liabilities at September 30, 1938

Endowment—for research (1)	$114,236.45
Endowment—for general purposes (2)	92,738.38
Endowment—dues of emeritus life members (3)	9,100.00
Endowment—dues of emeritus annual members (4)	500.00
Reserve fund	35,582.41
Permanent secretary's fund	12,042 00
Annual $1,000 prize fund	4,000.00
Unused grants to affiliated academies, etc	775.00
Accumulated income unappropriated	11,223.90
Total liabilities	$280,198.14

(1) Richard T. Colburn fund, $87,186.45; A. G. Stillhamer fund, $3,500; fees of deceased sustaining members, $7,000; fees of deceased life members, $16,550

(2) W. Hudson Stephens fund, $4,381 21; Michael P. Rich fund, $10,000; Hector E. Maiben fund, $31,448.17; Friends of the Association, $3,559; fees of living life members, $43,350.

(3) Jane M. Smith fund, $5,000; credits to fund from fees of $100 each set up from income from the fund or from general fund reverting on deaths of emeritus life members.

(4) Luella A. Owen fund

Cash Statement

Receipts

Balance, September 30, 1937	$ 19,321.71
Newcomb Cleveland gift to Grants Committee	1,000.00
Life membership fees	1,100.00
Revertment of grants	128 31
Donation to prize fund	2,000.00
Income from research fund	3,959.88
Income from general fund	3,421.47
Income from reserve fund	1,249 18
Income from permanent secretary's current funds	422.75
Income from Jane M Smith fund	312.90
Income from Luella A. Owen fund	18.19
Total receipts	$ 32,934.39

Disbursements

Grants for aid of research	$ 2,725.00
Grants to affiliated academies	2,035.00
Annual prize—to Philip R. White	1,000.00
For emeritus life members	300.00
For emeritus annual members	15.00
Life members' journal subscriptions	1,599.00
Fifty-year members' journal subscriptions	87.00
Maiben lecture—R C. Wallace	200.00
Safe deposit box and collection charges	40.61
Total disbursements	$ 8,001.61
Cash on hand, September 30, 1938	24,932.78
Total	$ 32,934.39

Permanent Secretary's Report

(Period October 1, 1937, to September 30, 1938)

Receipts

Annual membership dues and fees	$ 88,600.85
Life membership fees	1,100.00
Contributions from members	3,337.50
Grant from Carnegie Corporation of New York	4,000.00
On grant ($5,000) from General Education Board	2,500.00
Sales of publications	1,804.55
Miscellaneous receipts	2 698.10
Special journal subscriptions	2,436.00
Registration fees—Indianapolis meeting	2,819.00
Registration fees—Ottawa meeting	1,107.00
Receipts from exhibitors—Indianapolis meeting	5,304.50
Advance receipts from exhibitors—Richmond meeting	866.75
Total receipts	$116,574.25
Cash in banks, September 30, 1938	1,652.70
Reserve in Treasurer's hands	11,619.70
Total	$129,846.65

Disbursements

Subscriptions to journals, including foreign postage	$ 55,020.68
Allowance to Pacific and Southwestern Divisions	2,358.00
Expenses of Washington office	23,879 56
Expenses of General Secretary	329.48
Expenses of Treasurer	200.00
Circularizing for new members	6,536.47
General and travel expenses—Indianapolis meeting	3,741.03
Expenses of exhibition—Indianapolis meeting	3,563.00
Expenses of press service—Indianapolis meeting.	603.96
General and travel expenses—Ottawa meeting	2,959.44
Expenses of press service—Ottawa meeting	316.63
Preliminary expenses—Richmond meeting	1,028.96
Preliminary expenses—Milwaukee meeting	75.00
Preliminary expenses—Columbus meeting	40.00
Printing symposia	2,590.26
Life membership fees to Treasurer	1,100.00
Miscellaneous expenses	2,304.52
Expenses of Committee on Improvement of Science in General Education	1,314.56
Preparing and mailing radio broadcasts	3,878.87
Special journal subscriptions	2,454.00
Total expenditures	$114,294.42
Cash in banks	3,509.78
Cash in Treasurer's hands	12,042.45
Total	$129,846.65

REPORTS

DROPLET FISSION OF URANIUM AND THORIUM NUCLEI

THE fifth Washington Conference on Theoretical Physics, sponsored jointly by George Washington University and the Carnegie Institution of Washington, began January 26, 1939, with a discussion by Professor Bohr and Professor Fermi of the remarkable chemical identification by Hahn and Strassmann in Berlin of radioactive barium in uranium which had been bombarded by neutrons. Professors Bohr and Rosenfeld had brought from Copenhagen the interpretation by Frisch and Meitner that the nuclear "surface-tension" fails to hold together the "droplet" of mass 239, with a resulting division of the nucleus into two roughly equal parts. Frisch and Meitner had also suggested the experimental test of this hypothesis by a search for the expected recoil-particles of energies well above 100,000,000 electron-volts which should result from such a process. The whole matter was quite unexpected news to all present.

We immediately undertook to look for these extremely energetic particles, and at the conclusion of the conference on January 28 were privileged to demonstrate them to Professors Bohr and Fermi. It was subsequently learned that the particles had been observed independently by Fowler and Dodson at the Johns Hopkins University on the same day, by Dunning and coworkers at Columbia University on January 25 and by Frisch in Copenhagen two weeks earlier.

The experiments made in our Atomic-Physics Observatory at the Department of Terrestrial Magnetism of the Carnegie Institution of Washington are no doubt typical of similar experiments done at the other laboratories, but details of this work are not available to us. The experimental work here was done chiefly by my colleagues, R. B. Roberts, R. C. Meyer, L. R. Hafstad and N. P. Heydenburg.

For observations of the high-energy particles, an ionization-chamber, about five mm deep, was placed about three cm below the neutron-source and was so arranged that interchangeable copper disks about three cm in diameter could be placed on the collector, which was connected to a linear pulse-amplifier. The upper faces of these disks were then coated with the materials to be tested.

With the amplifier feeding a cathode-ray oscillograph the usual alpha-particle pulses were observed when a layer of uranium oxide was placed on the disk. On exposure to neutron-radiation from (Li + D) at 1,000 kv two additional groups of pulses were observed. The first group corresponded to the "neutron-recoils" from the air in the chamber, as previously measured with the same amplifier gain and without the uranium. These neutron-recoils gave pulses about four times the size of the alpha-particle pulses. The second additional group was 20 to 40 times larger than the largest "recoil"-pulse, thus coresponding to energies of 75 to 150 Mev released in the chamber, or 150 to 300 Mev total energy for each individual process. With paraffin surrounding source and chamber the yield was roughly 30 counts per min per μ A of 1,000-kv deuterons, which is a neutron-intensity corresponding to about 10,000 millicuries of radon-beryllium.

The yield from thorium was of the same order of magnitude.

No effect was observed from bismuth, lead, thallium, mercury, gold, platinum, tungsten, tin or silver with as much as 1/1000 the intensity of that from uranium and thorium.

No effect was observed with either uranium or thorium produced by the gamma rays from 3 μ A of 1,000-kv protons on lithium or on fluorine.

To determine roughly the energy-range of the neutrons involved in the fission-process, observations were made with the neutrons from several reactions, both with and without cadmium surrounding the ionization-chamber to filter out the thermal neutrons produced in the surrounding paraffin. Bearing in mind that the ratio of the counts with cadmium and without cadmium depends to a large extent on the amount of paraffin surrounding the source and chamber, the results of these tests may be deduced from Table 1 in which the relative number of "fissions" is given, with the total yield for uranium and thorium with high-energy neutrons, being approximately equal, taken as 100 on an arbitrary scale.

Neutron-reaction	Maximum neutron-energy	Uranium		Thorium	
		No Cd	With Cd	No Cd	With Cd
	Mev				
Li + D . .	13.5	100	70	100	100
D + D . .	2.5	100	70	100	100
C + D . .	0.5	100	10	0	0

From these comparisons it apears that the uranium fissions are produced by different processes for fast and slow neutrons, the fast-neutron process requiring more than 0.5 Mev but less than 2.5 Mev for effective operation. For thorium, on the other hand, only the fast-neutron process is effective, but somewhat surprisingly it also appears to require between 0.5 and 2.5 Mev.

A few words with regard to our present knowledge on the efficiency of these processes may be in order. The capture of a neutron with the energy of one thirtieth of an electron-volt gives rise to the release of 200,000,000 electron-volts of energy, but the production of a single slow neutron requires the expenditure of approximately 3,000,000,000 electron-volts of energy by the bombarding beam in the most efficient process yet known (deuterons on beryllium at 9,000,000 volts).

It may also be of interest to record that the measurements on this extremely interesting new process in uranium and thorium were the first experiments carried out with our new 5,000,000-volt equipment for nuclear physics, aside from nuclear measurements performed for voltage-calibration only. We take pleasure in recording our obligation to Dr. John A. Fleming, director of the department, for his vigorous support of our program in fundamental physics.

M. A. TUVE

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SPECIAL ARTICLES

POSSIBLE AVITAMINOSIS K PRODUCED IN MICE BY DIETARY MEANS

RECENT work on the possible relation of a deficiency of the fat-soluble factor, vitamin K, to the bleeding tendency in obstructive jaundice,[1] and loss of coagulability of blood in bile fistula dogs[2] and bile fistula rats[3] suggests that an avitaminosis K might be produced in mammals by dietary means alone. However, as far as the present writer is aware, a hemorrhagic disease in mammals comparable to that in chicks[4, 5, 6] has not as yet been produced. Consequently, this brief report is being made of a bleeding tendency occurring in mice maintained on a diet low in vitamin K and prevented by supplementation with the vitamin in the form of an ether extract of alfalfa.

In connection with a series of experiments concerned with the nature of the raw egg-white syndrome as produced in mice, it was apparent that when the tails were clipped in order to obtain blood bleeding continued for a longer time than is normally expected. Comparison of the clotting time with that of mice on a stock diet of Dog Chow showed that it took approximately twice as long for the blood of the experimental animals to coagulate as it did for the stock mice.

The diet that was used to produce the syndrome was made up as follows: powdered egg albumin (Merck), 61 per cent.; cornstarch, 27 per cent.; brewer's yeast, 5 per cent.; salt mixture, 4 per cent.; cod liver oil, 2 per cent.; agar, 1 per cent. This diet is relatively low in fat and might, therefore, be expected to contain only a limited amount of the fat-soluble factor. In addition, the albumin which makes up a large proportion of the diet has been reported to lack vitamin K[7] and yeast has been found to contain little or none of this factor.[8] To determine whether a vitamin K deficiency did exist, bleeding time was determined by Duke's method, using the clipped tails of three groups of mice: (1) stock mice on Dog Chow, (2) mice on the basal diet described above, and (3) mice on the basal diet supplemented with an ether extract of alfalfa equivalent to 5 per cent. of the diet. The tests were done after the animals had been on the diets for four to five weeks. Typical results are given in Table I.

TABLE I

Diet	Number of mice	Average bleeding time, minutes
Dog Chow	8	4.6
Basal	17	10.8
Basal plus extract of alfalfa	14	4.9

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[1] E. D. Warner, K. M. Brinkhous and H. P. Smith, *Proc. Soc. Exper. Biol. and Med.*, 37: 628, 1938.

[2] W. B. Hawkins and K. M. Brinkhous, *Jour. Exper. Med.*, 63: 795, 1936.

[3] J. D. Greaves and C. L. A. Schmidt, *Proc. Soc. Exper. Biol. and Med.*, 37: 43, 1937.

[4] H. Dam, *Biochem. Jour.*, 29: 1273, 1935.

[5] H. J. Almquist and E. L. R. Stokstad, *Jour. Biol. Chem.*, 111: 105, 1935.

[6] F. Schonheyder, *Nature*, 135: 653, 1935. Since this paper was submitted for publication it has been noted that H. Dam and J. Glavind (*Lancet*, 1: 720, 1938) referred to their unpublished experiments in which this condition was produced in rabbits and cured by vitamin K. They gave no details concerning the type of diet used nor the symptomatic picture that resulted.

[7] H. J. Almquist and E. L. R. Stokstad, *Jour. Nutrition*, 12: 329, 1936.

[8] H. J. Almquist, C. F. Pentler and E. Mecchi, *Proc. Soc. Exper. Biol. and Med.*, 38: 336, 1938.

It should be noted that one of the symptoms of the raw egg-white syndrome in mice is the excretion of large amounts of bile salts and bile pigments in the urine. However, the icteric condition is not responsible for the defect in bleeding, since the administration of vitamin K ameliorated the latter without decreasing elimination of the bile constituents.

While the results are not so striking as those reported for chicks, the constancy of the bleeding defect on the basal diet and its prevention by supplements of alfalfa extract suggest that a vitamin K deficiency has been produced. No more definite conclusion can be drawn until measurements of the prothrombin concentration of the blood have been made.

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WELLESLEY COLLEGE

THE SODIUM FACTOR OF THE ADRENAL[1]

IN our study of the adrenal factor, which causes retention of sodium in normal animals, we discovered that it could be separated from the vital factor, cortin, by repeated extractions with ethyl ether. The cortin content of our extracts was assayed on adrenalectomized cats,[2] while the presence of the sodium factor was determined by the effect on sodium retention in normal dogs.[3] In the latter instance injections were made subcutaneously in order to avoid the development of the refractory state.[4] A six-hour test period was employed.

We have made many preparations with high cortin content but no sodium-retaining power. For example, six different preparations, injected in amounts containing 20 to 80 cat units of cortin, caused no retention of sodium. On the other hand, extracts in which no separation of cortin and sodium factors had been made (which will be called whole extracts) gave very positive results. Seven different preparations injected in amounts containing 30 to 60 cat units of cortin caused a sodium retention of 37 to 54 per cent.

Extracts have also been prepared containing large amounts of the sodium factor but very little cortin, as illustrated in Table I.

TABLE I

Extract	Cortin content Cat units	Sodium retention Percentage
N	3	47
O	0	32
P	2	61
Q	1 +	70
R	0	50
S	5	55

The effects of these two factors have been studied on adrenalectomized animals. Two adrenalectomized male cats were treated with cortin alone for 130 days. The results were similar in each, the plasma sodium being maintained at the level characteristic of untreated adrenalectomized animals in the advanced state of insufficiency. The animals remained in good condition, showing no significant change in weight (Table II). Reduction of the cortin to the point of insufficiency produced little change in plasma sodium, while addition of the sodium factor to the cortin treatment caused a rise in plasma sodium to normal levels. Treatment with whole extract (cortin and sodium factor not separated) had a similar effect. The inability of the sodium factor to maintain adrenalectomized cats was demonstrated in the assay for cortin content of such extracts (Table I).

The effect of these factors has also been studied on two adrenalectomized female dogs, of which Dog 19 (Table II) is typical. When whole extract was injected the plasma sodium was maintained at normal levels, while treatment with cortin alone caused it to fall to approximately the level characteristic of adrenal insufficiency. As in the cats, the animals remained in good condition with cortin alone. Addition of the sodium factor to the cortin treatment caused a rise in plasma sodium to normal level.

TABLE II

Days after complete adrenalectomy	Weight Kgm.	Extract	Plasma Sodium mEq./1
		Cat ES	
61	3 70	Cortin alone, enough for maintenance	143.0
110	3 70	Cortin alone, decreased to point of insufficiency	141.0
130	3.60	Cortin alone, maintenance dosage	142.0
137	3.66	Cortin plus sodium factor	151.5
167	3 74	Whole extract	140.8
		Dog 19	
146		Whole extract	140.3
173	8.0	Whole extract	143.0
225	8.0	Cortin alone	130.5
243	8.0	Cortin alone	132.3
250	8.0	Cortin plus sodium factor	143.8

Our evidence indicates that there is a separate adrenal hormone responsible for sodium retention. In the absence of this hormone cortin maintains the adrenalectomized animal in spite of the diminished plasma sodium.

FRANK A. HARTMAN
HERBERT J. SPOOR
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[1] Aided by a grant from the Rockefeller Foundation.

[2] F. A. Hartman and W. D. Pohle, *Endocrinology*, 20: 795–800. 1936.

[3] G. A. Harrop and G. W. Thorn, *Jour. Exper. Med.*, 65: 757. 1937.

[4] F. A. Hartman, L. A. Lewis and K. P. McConnell, *Endocrinology*. (In press.)

IMMUNIZATION TO INFECTIOUS MYXOMATOSIS

Infectious myxomatosis (Sanarelli) is known to be a highly specific and an almost invariably fatal virus disease for the domestic rabbit. More than 2,000 rabbits from our inbred colony have been tested with this virus under laboratory conditions in various experiments over a period of ten years. Every normal animal has proved susceptible, not a single one has escaped a fatal issue. Death follows in from 8 to 11 days after proper exposure to the active agent. It was demonstrated by Shope that the rabbit could be protected against this disease by previous treatment with the fibroma virus. We have confirmed and extended this observation. The fibroma virus, by all portals of entry, usually confers a solid and lasting immunity to the otherwise fatal myxoma.

Attempts to immunize the host with the myxoma virus attenuated by heat or chemicals have in the hands of a number of workers proven ineffective. It is in fact the usual experience of all workers with the viruses that little if any immunity results with the use of heat-inactivated virus.

We have found that some resistance to myxoma can be conferred upon the rabbit by previous intradermal injections of heat-inactivated tissue virus (60 C.°-30′). This refractory state may be enhanced by the addition of the viable type III *pneumococcus* or *Bact. lepisepticum* to the heated tissue vaccine, but not by the addition of the vaccine virus or viable tumor cells (Walker's rat carcinoma 256).

That the phenomenon is one of immunity is indicated by the fact that rabbits so treated give a marked allergic response to intradermal injections of the myxoma virus. The disease in many cases is aborted or its course mitigated. The skin lesions are more restricted and circumscribed. Discrete tumor-like nodular formations, instead of spreading oedematous lesions, appear on the ears and eyelids as well as on other parts of the body. Death is delayed. Many animals survive, some fully recover, others show chronic asthmatic symptoms with conjunctivitis. Animals that survive are solidly immune to massive intradermal injections of the myxoma virus except for the local response at the site of injection. Antibodies are present to an appreciable titer as determined by complement fixation. In general the titer of the serum of the treated animals at the time of infection is an index of their degree of resistance. The results suggest that accessory agents may be useful in attempts to establish immunity in other virus diseases where our efforts with heat-inactivated virus have thus far failed. Details of these experiments will be given in a forthcoming series of papers.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A MODIFICATION OF THE SET-UP FOR WICK CULTURE

In the set-up for growing plants by the wick-culture method as previously described by the writer[1] the main wick (the sheet of absorbent material on the surface of which the plant roots develop) is supplied with solution by means of a number of secondary wicks dipping into the solution contained in a pan situated near the upper edge of the main wick. Regulation of solution supply is accomplished by varying the number and width of these secondary wicks as well as the solution level in the pan.

While this method has been used with entire satisfaction by the writer, it has been found almost prohibitively difficult by other workers in this laboratory. Recourse has been had, therefore, to dripping the solution onto the upper edge of the main wick. The modified set-up for this purpose is illustrated diagrammatically in Fig. 1, in which (*a*) indicates the main wick; (*b*) the sheet of plate glass against which it rests; (*c*) is a piece of plate glass about 10 cm wide which is supported in a position perpendicular to (*b*) near its upper edge, and at a distance of 1 to 1.5 cm from it, on which the upper edge of the main wick (*a*) rests. The solution dripping from the tube (*e*) falls on a wad (*d*) of absorbent cotton or glass wool placed along the upper edge of the main wick and serving to distribute the solution laterally across its width. We have found dripping the solution on at two points along its width entirely satisfactory for a main wick of a width of 45–60 cm.

A Wick Arrangement for Subdivision of the Solution Stream

A slow drip of solution of constant rate is readily obtainable by the use of either a capillary resistance device such as described by Trelease and Livingston,[2] by Shive and Stahl[3] and by Zinzadze[4]; or a small-volume metering pump such as has recently been devised by the writer (shortly to be described). For subdivision of the solution stream (for dripping on at several points of the upper edge of the main wick) the wick arrangement illustrated diagrammatically in Fig. 2 has proved very satisfactory. It will be noted that the device contains no moving parts and no small orifices, and that the solution passing through it need not come into contact with any material other than glass.

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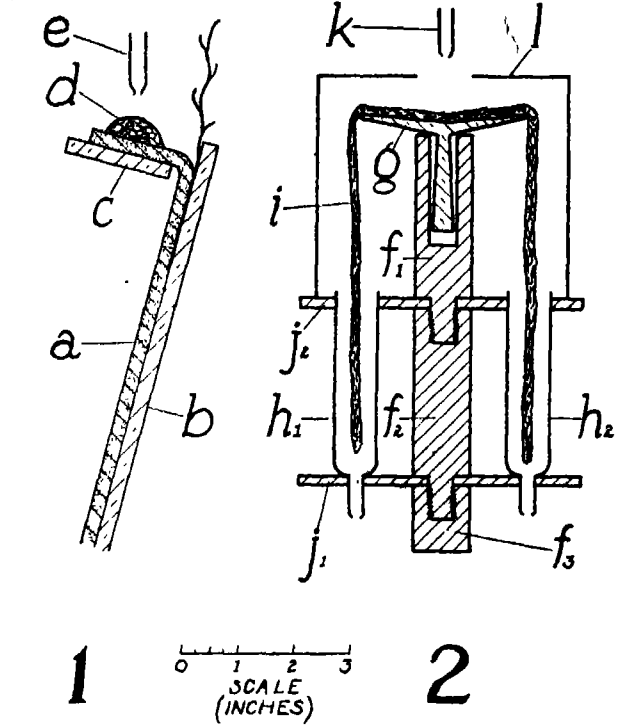
[1] *Am. Jour. Bot.*, 24: 185–187, 1937.



FIGS. 1 and 2 (the scale applies only to Fig. 2.)

Referring to the figure, (f_1), (f_2) and (f_3) are sections of brass rod which screw together to form a single central column. At the two points of junction of the sections are mounted the circular brackets (j_1) and (j_2), in which are holes for holding the funnel tubes (h_1) and (h_2). On the top of the brass column is mounted a shallow glass dish (g)—made from the inverted foot of a wine glass or sherbet glass, with the stem suspended in a deep recess bored in the top of the column. A wick (i), consisting of a strip of glass cloth or tape,[5] is placed with its central portion resting in the shallow glass dish (g) and its ends suspended in the funnel tubes (h_1) and (h_2). (l) is a glass cover for maintaining the humidity around the upper portion of the wick (i). It is made from a small battery jar, inverted, with a hole bored in the bottom for the inflow tube (k). The apparatus is mounted by means of burette clamps (not shown) on the half-inch rod of a laboratory stand.

In operation of the device, the incoming solution stream, dripping from the inflow tube (k) onto the central portion of the wick (i), is subdivided by the capillary action of this into two outgoing streams dripping from the ends suspended in the funnel tubes (h_1) and (h_2). From these the solution flows to the wick-culture apparatus below. If the two portions of the wick are closely equal in width and length, then the solution streams dripping from them will also be found to be closely equal (readily within 5 per cent., which is adequate for the purpose in hand). Simultaneous subdivision into four streams has been accomplished without difficulty in this manner.

With regard to the mode of operation of the device, it may be interesting to note that there is a tendency to a pulsation or rhythm in its action. Liquid tends to accumulate in the shallow glass dish, and then to drain out through the ends of the wick. It would seem therefore that, at least in part, the mode of action of the device is that of an intermittent siphon with multiple outlet tubes.

M. A. RAINES
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[2] SCIENCE, 55: 483–486, 1922.

[3] *Bot. Gaz.*, 84: 317–323, 1927.

[4] SCIENCE, 81: 540–542, 1935.

[5] Cloths and tapes woven from spun glass may be obtained from the Fibre Products Division of the Corning Glass Works, Corning, N. Y.

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CONTRASTS[1]

By Professor FREDERICK G. KEYES

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

ANY alumnus of Brown would be very sensible of the honor of being asked to take part in as important an event as we celebrate to-day. When I received the invitation to speak, my first impulse was to rejoice for the opportunity to express my gratitude for the abundant benefits Brown extended to me some thirty years ago. My second thoughts turned to dwell on the significance and meaning of the splendid Metcalf Research Laboratory, designed exclusively for graduate study and research.

That this addition had long been a practical necessity was clear these many years to those who have followed at first hand the rise of the department to a position of outstanding importance. Because of my nearness to the university and my membership on the department's visiting committee, it was easy to comprehend the time and patience expended under what henceforth will probably be referred to as "the old conditions." Professor Kraus and his colleagues will no longer spend valuable time in effecting the compromises required heretofore to provide adequate opportunities for a rising level of graduate students. It is a great joy to know that the efforts of the staff to promote the progress of graduate study and research will take place in a setting worthy of Brown University and of the man whose wisdom and generosity have made the dream of the research laboratory a reality.

Sometimes it is a salutary procedure to pause occasionally, as on the present occasion, to survey the steps which have led up to the present position. The exercise puts events in their proper relationship, promotes a decent humility, induces a just pride, emphasizes the eternal verities, makes for simplicity and enables one to lay the course for the future on a more assured basis.

Brown University was the seventh American college

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[1] An address delivered at Brown University, Providence, R. I., on the occasion of the dedication of the Metcalf Research Laboratory of Chemistry on December 28, 1938.

[illegible]e nine founded before the Revolution, and all were established exclusively in response to the need for an educated ministry. The college started with a president, James Manning, and one student; without buildings, library or endowment, in the midst of Baptists hostile to ministerial education. The charter of the college was a document of extraordinary liberality, notwithstanding an age of bitter sectarianism in which it was written. It provided that the corporation be composed of four denominations, prescribing the exact number of each to prevent non-Baptists from ousting Baptists and *vice versa.* It stated also that all teachers except the president were to be exempt from religious tests of any kind. Finally, and most remarkable, was the exclusion of all teaching of "sectarian differences of opinion," and "youth of all religious denominations" were on an equal footing in every respect. As a commentary on the present state of tolerance in certain parts of the world, the corporation voted on September 6, 1770, "that the children of Jews may be admitted into this Institution and entirely enjoy the freedom of their religion without any constraint or imposition whatever." In 1774, by the terms of a ruling, Seventh Day Baptists were not required to attend church and Quakers were exempted from a law prohibiting students from wearing hats indoors. Tolerance relative to science was written into the charter, which stated that "the public teaching shall in general respect the sciences."[2] This liberal and catholic spirit is remarkable, for the temper of the time was quite the contrary. Thus, at Yale a student could only be admitted who was "grounded in polemical divinity according to the Assemblies' Catechism, Dr. Amos Medulla, and cases of conscience," and similar restrictions existed at each of the six colleges whose founding preceded that of Brown.

Chemistry had been taught in medical schools abroad in the 1790's, but instruction in the science at Brown does not appear until the medical school was established in 1811 under President Asa Messer (1802–1826), in the course of whose administration enlarged courses were given in mathematics as well as instruction in mechanics, astronomy, animal and vegetable physiology, pneumatics, hydrostatics and geology. Moreover, the "almost worthless" philosophical apparatus was replaced through the generosity of Nicholas Brown and Thomas P. Ives, "adapted for all purposes of illustration." The first laboratory, also due to the generosity of Nicholas Brown, was set up in Rhode Island Hall in 1841, which contained a museum and lecture rooms. This patron's gifts and bequests amounted in all to $160,000 and set an example to friends of Brown and other colleges. A sum of possibly eight to ten times this amount would represent equal purchasing power at the present period.

Following the Civil War the physical equipment was much improved and the friends of the university gave the library building, Slater Hall, Sayles Hall, Rogers Chemical Laboratory, Wilson Hall for Physics, the Ladd Observatory. At the close of Benjamin Andrews's administration there were nearly a thousand students, of which 101 were graduate students and the staff had grown to 90. Under W. H. P. Faunce's administration the university funds were considerably increased; in 1914 to a total of more than three times that in the previous 150 years, while the physical plant was further enlarged.

The foregoing hasty sketch brings us to the moment of a great change in the role which the universities of the United States were to play in the future; a role, we hope, that will last a long time, provided humanity is tough enough to resist the collective madness surging through the world these twenty years.

The interval between the Civil War and 1914 was of course one of steady development of science, industry and transportation in the United States. The country depended almost entirely upon Europe for goods of exceptional quality, for scientific apparatus, for dyes, pharmaceuticals and numerous other products. Graduate study and systematic research in the universities had made a beginning in the 1880's under the guidance of a few German trained chemists, physicists and mathematicians. By the turn of the century, however, Germany had become the foremost scientific nation in the world and was beginning to straddle it like a Colossus. Nothing apparently could resist the progressively dominating influence of Germany in every department of art, science, industry and world commerce. An insistently proclaimed excellence in every field set the ultimate standard as German, and the hall-mark of the American scholar was a German university degree. The models of scientific research and graduate study were faithfully copied in the American universities, while an increasing stream of freshly Ph.D.'d students from Göttingen, Berlin, Heidelberg and elsewhere in Germany was not infrequently distinguished by a curiously accented German speech which often disdained American pronunciations of the commonest chemical substances. The American student content with graduate study in an American university was believed to be distinctly second rate and was usually offered second-rate opportunities, if any.

Our large-scale manufacturers employed none or few scientific men, and employers frequently selected German and Austrian engineers for responsible positions. Many manufacturers took over, in their entirety, developments perfected abroad for American exploitation, and in general cut themselves off from the great body of organized and coordinated knowledge brought together by thousands of university and industrial investigators. When German or other foreign competition reduced profits, it was always possible to raise the tariff.

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[2] Science probably included geography, arithmetic, algebra, Euclid, trigonometry, surveying, navigation and astronomy.

To-day, a scant twenty-five years later, we look back on an interesting phenomenon: a miracle, as far as pure and applied science is concerned, in every respect as striking as the Greek revival some 2,400 years ago. From a relatively second- or third-rate contributor to scientific advance prior to 1914, the United States is now leading the world in nearly all scientific fields, and the quality of the product as well as the volume is growing steadily. It is a justifiable cause for satisfaction to the university, its graduates and friends, that Brown has contributed generously to this progress in all fields, and particularly in the field of chemistry. It is often the pleasant custom on occasions like the present to permit oneself the indulgence of a good measure of generous comment. In the presence of this audience I shall merely note as every one does the fine quality of the physical plant and the esprit de corps of the scholarly staff of this early American university. The satisfaction arising from the opportunities Brown generously offered have grown richer with the years, and we may now rejoice that these opportunities are preserved and further enlarged for the benefit of the students of the present and the future.

It would be interesting, did time permit, to digress and survey the exploitation of science by industry which runs parallel with the extraordinary revival of science just cited. Relative to the first decade of the century, progress has been striking, but due consideration of the many aspects of the subject convinces one that continued advance in science and industry can not be maintained unless scientific methods and an enduring probity are practiced in the conduct of government, in the drafting and application of laws, and in the conduct of public business generally. Indeed the possibility is by no means negligible that the effects generated in the past six years through the amazing spread of irrationality and emotionalism in government may have been given sufficient momentum to bring about the collapse of as splendid a foundation as ever existed for the most alluring prospect in civilization the world has ever known.

It is quite evident that this remarkable period in the United States, which the future history of science will duly record, is based on a substantial preparatory period. We know that this was the case with the Greek revival, although the induction period apparently extended over several centuries, whereas it is difficult to assign more than a hundred years at most in our own case. That it should be short seems reasonable in view of the character of the people, amongst whom were a normally disproportionate number of intelligent, independent and courageous men and women who were able to function in an atmosphere of freedom without restrictive interferences of political origin. Generous consideration must also be given to the influence of nineteenth century European contributions to scientific development, often brought directly by students returning from study in the foreign universities.

Only a cursory reading of the Federalist papers is enough to show the character, probity and insight of the men available for leadership in the states during the eighteenth century. That they would recognize the fundamental necessity of providing educational facilities for the developing nation goes without saying, and the impulse grew finally to a veritable passion. Perhaps the stimulating climate of the North Atlantic seaboard played its part as well as the intellectual and moral qualities of the early settlers, but the fact remains that the progress of the American colleges was uninterrupted and scientific work of the first order was accomplished in the early period by Franklin, Joseph Henry, Priestley, Hare and others.

As already stated, after the Civil War large numbers of our younger men attended the German universities. Thus, J. W. Gibbs, A. G. Webster, Rowland and many others came under Helmholtz's influence, while the number of chemists awarded the doctor's degree grew year by year down to 1914. I believe it is substantially true that in science the influence of these German-trained young men provided a technically deep and sound foundation which, functioning under American conditions, produced American chemistry as well as American physics and mathematics. Beginning with the turn of the century, their influence had begun to have a pronounced accelerating effect on research.

The presence of a relatively large number of enthusiastic and talented young scientific men in our universities is certainly one of the necessary factors for good progress, but this alone would have been insufficient to account for the American miracle. The factor of tremendous importance, perhaps even decisive, was indubitably the existence of our free institutions, financially independent and unhampered by centralized bureaucratic control. Their liberating influence over successive generations produced a type well suited to widening intellectual frontiers. Self-reliance and resourcefulness probably come to be inherent characteristics in a people who have the stamina needed to settle a continent in a relatively short time.

The financial independence of our universities permits great freedom in the development and exploitation of a variety of educational objectives which has had an extraordinary stimulating effect on our university students, in spite of the fact that good judgment has not always been exercised. It has also made possible abundant laboratory facilities, which accounts for the manipulative skill characteristic of the American student. The rising prosperity of all classes of the rapidly growing population in the midst of unparalleled natural resources is another factor not to be neglected. Under such conditions the probability that all grades and varieties of talent in the population will be given an opportunity to develop is very great. This is the fruition of the principle of equality of opportunity, without which no society can discover a large fraction of the varied abilities latent in its people.

The phenomenon of the founding and the endowment of large numbers of colleges and universities generously and consistently supported for three hundred years by private enterprise and generosity is certainly without parallel in recorded history. The growth of this almost universal generous public spirit is moreover a distinctly American phenomenon[3] and it is responsible for the establishment of every sort of institution in the public interest. It should be remarked that in isolated instances free institutions have been established in Europe by groups of public-spirited citizens. These at the present time have become defunct or seriously damaged financially. Where, however, in the established circle of history can an institution resembling the Rockefeller Foundation be found, to name only one conspicuous example of a product of private generosity characteristic of, shall I say, "economic royalists" and "entrenched greed"? Where also does there exist in the record of the past a single instance of privately endowed organizations establishing research institutes, repairing war's destruction, feeding the starving and clothing the naked the world over? It would take more than my allotted time this afternoon to even outline the manifold beneficences and varied civilizing influences that have flowed in an ever-increasing volume from the remarkable public spirit characteristic of the citizens of the United States. Fundamentally we owe our free institutions to the existence of this spirit, and through the opportunities afforded, the talented men and women of the United States have been given unparalleled facilities to exploit their abilities in an atmosphere of freedom according to the scale of their inherent abilities. It is unquestionably our free institutions that have provided the essential basis for the greatest scientific and industrial awakening on record.

Brown University is one of the institutions that has helped to bring about this great miracle. The question arises inevitably: Will the conditions and circumstances which have supported the movement persist and allow continued progress? What, for example, is the prospect that we will often again assemble to rejoice under like circumstances in the gift of a building provided by private generosity? Unfortunately we are not without indications that influences and trends have been developing more or less parallel with the scientific and industrial rise which may eventually crush or even destroy the unique qualities of enterprise, courage, independence, resource, tolerance and public spirit inherently responsible for the American phenomenon. These influences for the most part have the appearance of being of direct political origin, although fundamentally, in a country organized as the United States is, subversive political influence is traceable either to lack of popular understanding and interest or to stupid human inability to defer apparent temporary advantage for future permanent gain. Certainly if the present destructive financial and other governmental tendencies continue, the descent from the heights to which we are ascending will be spectacularly rapid. It can not be overemphasized that processes of destruction once in motion come to a halt on levels where the distribution of poverty can contrast sharply with the widest diffusion of prosperity and well-being ever known to mankind. The incentives to public generosity are certainly in danger of drying up, due largely to unwise fiscal policies, intemperate legislation and increasingly huge taxes. Little imagination is required to foresee that if the trend is not halted, all private endowments will be irreparably damaged and the evolution of democratic institutions retarded. The loss of financial freedom on the part of our universities and manifold public institutions involves not only a staggering material loss to the people of the United States but the destruction of social values and the obliteration of a civilizing spirit which is sorely needed in a world where the terrors of ancient human savagery press upon us from every side.

I realize there are those who think otherwise, at least in part. The great state universities will be cited as examples of politically supported institutions. But does any one doubt that they would stand at their present level, in serious activities, were it not for the example, performance and competition of the independent universities that still serve as models and which function for half the college and university students in the country. Should any one doubt the dire calamity that would attend the passing of our free institutions, let him investigate the opportunities, equipment and facilities of European universities at the mercy of political functionaries. The experience of residence abroad will show the interested observer the utter poverty of physical equipment except in a very few centers, and also disclose the restrictions and centralized bureaucratic control that retard progress while suppressing enterprise and initiative. University men and women abroad too often carry on their scientific labors in poverty, with poor facilities and no assistance, while burdened with teaching and routine prescribed by the political bureaucracy in power at the moment. The few of genius and talent upon whose efforts much of the prosperity and well-being of the masses depend function (in Europe) with difficulty, without adequate rewards or incentives, while spiritual evolution and advance in physical welfare are slowed to a fraction of that possible under our favorable conditions.

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[3] Private charities and the establishing of independent institutions proceeded in England during the nineteenth century, but the magnitude of the development was far less than in the United States, as would be expected, on the basis of the greater natural resources in the latter country.

As Arthur D. Little says in his fine essay "The Fifth Estate"—"Our civilization is certainly imperiled, but there will be no downfall if mankind can be taught to follow the light already before it." "In the past the world suffered grievously from lack of knowledge; today it suffers from its rejection or misapplication." "With the recognition of the spirituality of science and the divinity of research and discovery should come larger interests and a new breadth of vision to the average man, and to us all an acknowledgment of the steadfast, purposeful striving shown in the development of the created world, together with a reverent appreciation of man's privilege to aid and further this development."

Professor Kemmerer, of Princeton University, has shown in a recent article that the endowments of our universities are already in danger and indicated clearly the undermining of democratic institutions brought about by unsound government financing.[4] He cites what should be an obvious fact, curiously unappreciated by the holders of 113,000,000 insurance policies, that it is the creditors who must pay ultimately for the consequences of unwise fiscal policy. These creditors are of course the people who hold bonds, our universities and educational institutions (1 and ½ billion), insurance companies (100 billion dollars), hospitals, museums, libraries, foundations, religious organizations; in fact, every institution holding bonds and mortgages. As Professor Kemmerer states: "These creditors are our most conservative investing classes—classes whose welfare is a matter of such great social importance that we protect many of them by special laws which restrict the investment of trust funds to a limited and supposedly safe field of investments." That the situation is now grave is beyond question.

There is also the further problem. Where are our independent institutions to turn in the future for the additional financial support needed to promote research and improve educational procedures? The adoption of the income tax formulated on the so-called principle of "the capacity to pay" has, to say the least, made it very difficult for generous public-spirited citizens to give money to the universities or other public institutions and it has already gone far to promote the tendency to "let the government do it." That is sad enough, but the "highly progressive income, inheritance and gift taxes on the part of both the national government and the states, taxes whose combined rates in the higher brackets are already the highest of any advanced country in the world" (to quote Professor Kemmerer) makes it likely that the impulse to generous giving will soon die for want of the means of reasonable exercise.

It is in order to ask what can be done to halt the danger. In a free country we have the glorious right to discuss a situation, and a danger promptly recognized is often partly forestalled. In a true democracy it is moreover the business of every one to exert himself in the public interest according to the measure of individual ability. First: Every citizen should be made aware that the qualities of public spirit and public generosity so wide-spread in the United States are unique in the history of the world, and without parallel anywhere except to a far lesser degree in England. Second, the examples by suitable classification of our privately endowed educational institutions, hospitals, scientific and medical foundations, charitable and religious organizations, museums and student-aid organizations should be clearly described and the present amounts of the endowments given. It is important also to give for comparison the number of similar institutions in the rest of the world with the amounts of their endowments, before the war and at present. I understand Professor P. G. Wright has prepared a report under the Duke University Endowment which gives data for certain independent institutions in Germany, Austria and France. Third, the viciously-false unsupportable statements incessantly promulgated in the United States that only a few wealthy individuals pay the taxes expended by government should be vigorously refuted by appeal to the facts. These facts are available, and there are many ways in which their significance and importance can be made clear to every one. An important item related to this which seems to have escaped the attention of a very large number is that a continuation of the present fiscal and other government policies is endangering the hundred billion dollars worth of insurance back of 113,000,000 widely held policies. Fourth, the attention of people should be focussed on the relation of our free institutions to the public welfare and to the astounding progress in civilizing influences they have promoted. This can perhaps be most strikingly exhibited by comparisons with conditions in other countries since 1900, and especially the contrasting wide-spread prosperity in the United States amongst those possessing industry and goodwill should be made crystal clear by numerical elaboration. Fifth, much of the criticism about the incompetence and demagogery of politicians, while too often justified, should be abandoned for a policy of positive assistance to those in public office who are capable and sincere. It is commonplace that under our system politicians must have "causes," and other things being equal, it is ridiculous to suppose they wilfully prefer false ones. It seems clear that it is the people with insight and intelligence who should provide the causes and support the politicians who demonstrate their sincerity by doing effective work for them in the form of providing and disseminating accurate data and information relevant in the promotion of all causes which will insure the preservation and growth of a free, just and liberal society.

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[4] E. W. Kemmerer, *Atlantic Monthly*, 160: 729, 1937.

We belong to a group which has been selected by the so-called higher educational system of our country. Favored by natural endowment we have been enabled to utilize magnificent advantages provided by our free institutions. Advantages, facilities and an environment of freedom which can exist on the present level only as long as the good will, the generosity, the tolerance and the unique public spirit which created them are preserved.

Many of you will join with me in confessing, however, that while passively grateful for our advantages, we have scarcely done anything actively to insure that the advantages we enjoy will be passed on undiminished and enhanced, to our successors. I am convinced that the greater part of the men in public office do not realize the nature or value of that which is so commonplace in our country. It is our duty to take action without delay, perhaps through our scientific societies in a concerted effort to preserve our heritage of financially free institutions, and save from perishing the priceless spirit of public generosity which brought them to their present flowering.

The message I bring has a somber cast; perhaps too serious a tone at the hour of rejoicing. But we have come upon evil times and see the finest fruit of our labors being misused increasingly to blight the spirit of mankind and to blacken his soul. Alas, no one wishes more than I do that the poisons distilled into the world by addled brains since I trod this campus thirty years ago could be spontaneously neutralized. We, however, more than any one else, have the imagination to envisage the evils and the power to neutralize the poisons by uniting and exerting ourselves promptly and courageously. In doing so, we will give tangible evidence of gratitude for gifts received, and which is more important, save from perishing the divine civilizing spirit that gave Brown University the Metcalf Research Laboratory.

FREDERICK G. KEYES

MASSACHUSETTS INSTITUTE
OF TECHNOLOGY

OBITUARY

SAMUEL PRENTISS BALDWIN

SAMUEL PRENTISS BALDWIN, widely known for his pioneer work in the trapping-and-banding of wild birds and for his Research Bird Laboratory, was born at Cleveland, Ohio, on October 26, 1868, and died of coronary thrombosis in that city on December 31, 1938. He was the son of Charles Candee and Sophia (Prentiss) Baldwin.

His father, a judge of the circuit court of appeals, was one of the founders and principal supporters of the Western Reserve Historical Society and was deeply interested in archeology and geology. The son inherited his father's tastes, and was a trustee of the Historical Society from 1907 until the end of his life.

After graduation from Dartmouth College in 1892, Prentiss studied in the Law School of Western Reserve University and was the first to receive its degree of LL.B. in his class of 1894. For six years he was a member of law firms in Cleveland, but withdrew in 1900, and for a considerable time thereafter was engaged more or less continuously in business.

At intervals in this early period the law had to give way to geology, when Mr. Baldwin took part in geological expeditions to the Muir Glacier and to New Mexico; but after 1900 he returned to his first love, natural history, and devoted himself more or less completely to ornithology.

In 1914 Prentiss Baldwin became interested in the newly devised method of banding wild birds—encircling one of their legs with a numbered, aluminum ring—so that, if later recovered and reported, incontrovertible data upon their wanderings and longevity could be secured. In the course of these practises, which were systematically conducted at his Gates Mills farm in Ohio, in summer, and at Thomasville, Ga., in winter, Dr. Baldwin devised traps for securing large numbers of living birds, and originated the method of trapping-and-banding adult birds, which by 1920 had become so successful that it was approved by the Biological Survey. This governmental agency, which took over the work of the American Bird-Banding Society in 1920, soon became the "clearing house" for the registration of the recovered aluminum bands, that began to flow in from all parts of the country. As a result of this movement four Bird-Banding Associations, The Inland, Eastern, Northeastern and Western, were established, thus covering a large part of the continent of North America, and affording all necessary assistance to their thousands of volunteer workers. It is estimated that Dr. Baldwin, who became the honorary president of all these organizations, and his assistants alone have banded between 50,000 and 60,000 individuals.

Since 1914 Prentiss Baldwin was devoted to the intensive study of ornithology at what became known as "The Baldwin Bird Research Laboratory" at his Gates Mills farm, from which have issued upwards of thirty more or less elaborate papers, relating to the physiology, development and life-history of birds, and based upon his own work and that of his associates. The elaborate treatises on "The Physiology of the Temperature of Birds," which involved more than fifty thousand determinations, and "The Measurements of Birds" appeared in the Scientific Publications of the Cleveland Museum of Natural History.

Dr. Baldwin soon fixed upon the little house wren as the one species that was best suited for the study of many avian problems, touching distribution, migration, anatomy, physiology, development, behavior and, more specifically, body-temperature and sexual relations in domestic life, to mention some of the subjects which had engaged his attention. In short, the house wren, through studies at the Baldwin Laboratory, became in some measure for ornithology what the diminutive fruit-fly, *Drosophila*, is for the science of heredity or genetics. The wren, like *Drosophila*, is easily handled and controlled; it nests readily in artificial boxes, wherever placed, and can be trapped in its nestbox and quickly caught in a hand-net for examination. If it does not submit complacently to interference, it seldom or never deserts its young. Through the testimony of the numbered bands it was shown that house wrens do not mate for life, but that on the contrary they often change mates between seasons, and even between broods of the same year. It was also proved that not more than one third of all marked individuals return to their nest or to the locality in which the young were hatched in two successive years.

Many ingenious electrical recording devices, originating in the Baldwin Laboratory, were used in determining the temperature changes which the growing young undergo from an early egg-stage to adolescence and in recording visits of the parent birds to their nest when tending their young. Experimenters in this laboratory also perfected an instrument for taking motion pictures of the living embryo *in ovo*, thus showing successive stages in embryonic development by use of a microscope with a camera-attachment, the wren's egg making a suitable subject because of its small size and hardihood.

Dr. Baldwin was a trustee of the Cleveland Museum of Natural History for nearly sixteen years, or from 1923 until his death, and in many ways gave it his generous support. He received the degree of D.Sc. from Dartmouth College in 1932, was a fellow in the American Association for the Advancement of Science, the Geological Society of America, the American Ornithologists' Union and the Ohio Academy of Science, and was a member of the American Society of Naturalists, the American Society of Zoologists, the British Ornithologists' Union, Deutsche Ornithologische Gesellschaft and the Australasian Ornithological Union.

Through his efforts and those of his assistants Dr. Baldwin had gathered through the years a rich store of scientific data upon birdlife, which, if properly edited, should make a most outstanding monograph. On this achievement Prentiss Baldwin's mind and heart were fixed, and he had worked on it with great singleness of purpose for many years. It is to be hoped that this work, for which he had labored so industriously, but which, unfortunately, he did not live to complete himself, may yet be given to the world.

Dr. Baldwin was married on February 15, 1898, to Miss Lilian Converse, daughter of Leonard Hanna, of Cleveland.

In his personal relations Prentiss Baldwin will be remembered as a loyal friend, who was ever ready to extend a helping hand, especially to young men who were devoted to science, and was determined that all should receive their just dues. He took a broad view of his opportunities, and freely gave his time, his effort and his means for the protection and preservation of the wild life of the countryside. The many friends of Dr. and Mrs. Baldwin, and particularly the members of Western Reserve University, of which he was a research associate in biology, can never forget the generous hospitality which they have enjoyed in their beautiful home.

FRANCIS H. HERRICK

RECENT DEATHS

DR. EDMUND B. WILSON, Da Costa professor emeritus of zoology at Columbia University, died on March 3 at the age of eighty-two years.

DR. CHARLES SUMNER PLUMB, professor emeritus of animal husbandry at the Ohio State University, died on March 4 in his eighty-ninth year.

DR. ARTHUR ALFRED BRYAN, agronomist of the Iowa State College, died on February 22. Since 1934 Dr. Bryan had been in charge of the corn improvement program carried on by the Iowa Agricultural Experiment Station in cooperation with the U. S. Department of Agriculture.

DR. ARTHUR PHILEMON COLEMAN, professor emeritus of geology and formerly dean of the Faculty of Arts of the University of Toronto, died on February 26 in his eighty-seventh year.

HOWARD CARTER, known for his discovery and exploration, in association with the fifth Earl of Carnarvon, of the tomb of Tut-ankh-Amen, died on March 2 at the age of sixty-six years.

SCIENTIFIC EVENTS

THE HENRY G. LAPHAM FIJIAN EXPEDITION

ON June 27 Dr. C. M. Cooke, Jr., leader and malacologist, Mr. Y. Kondo, assistant malacologist, and Mr. Elwood C. Zimmerman, entomologist, Bishop Museum scientists, departed from Honolulu aboard the S. S. *Monterey* for Suva, Fiji, to collect mollusks and insects for the museum. The duration of the trip was three months.

The expedition was named for Mr. Henry G. Lapham, of Boston, in appreciation of his interest and financial assistance to the museum's program of exploration in the Pacific. Dr. C. M. Cooke, Jr., also gave generously to the fund and personally financed exploration in Lau Province. Without the aid of these two men it would have been impossible for the staff to have made the trip. The museum is greatly indebted to them.

Because of illness at home Dr. Cooke was recalled to Honolulu after three weeks in the field. Mr. Zimmerman assumed the post of acting leader and with Mr. Kondo and Jacob Ulumira, a Fijian assistant, continued exploration, following closely the itinerary made up at the beginning of the expedition.

During the course of the expedition collections were made in the following areas: first, Ovalau island; second, Viti Levu, the largest island of Fiji, upon which exploration was done in the Rewa, Serua and Tholo north districts; and third, in Lau Province, or the eastern Fijian islands, where Munia, Vanua Mbalavu, Mango, Lakemba, Oneata, Naiau and Moala islands were visited. Approximately sixty islands were seen and notes were taken on the appearance and, where they were viewed closely enough, the extent of the forests upon them.

The expedition was principally one of reconnaissance. It was a preliminary survey of the region, and one of its main purposes was to determine the best type of exploration for this area and the places where intensive field work should be done when funds are available for future expeditions. As a result of the experience gained in this exploration it will be much easier for the staff to plan future Fijian expeditions.

The staff returned from the field on September 28 with outstanding success and comprehensive collections. It is estimated that the entomologist procured approximately twenty-five thousand specimens; the number of land shells taken has not yet been ascertained, but a splendid cross section of the fauna was obtained by concentrated work. In entomology and malacology many "lost species" were rediscovered which evidently had not been collected since the types were taken. The museum's collections of Fijian land shells and insects is now second to none in numbers and comprehensiveness. Many new species of land shells were collected, and the number of new species of insects obtained must be counted by hundreds. The success of the expedition will not be truly known until the material has been prepared, specimens studied by specialists, data sifted, and the results published. These accomplishments will not be realized for many years because of the bulk of the material.

During most of the trip the scientists were fortunate in having favorable weather, but, as is to be expected in that region, a number of collecting days were lost because of unpropitious weather. The expedition was planned for the "dry season" in order to facilitate field work, but, as the drier season comes in the winter, the entomologist found that, with few exceptions, the summer insects, such as many Lepidoptera, buprestid and elaterid beetles and many others, were in the nymphal, larval or pupal stages, and adults were either rare or entirely unobtainable. The season evidently had no effect on land shell collecting.

ELWOOD C. ZIMMERMAN

THE WORK OF THE COMMONWEALTH FUND

THE twentieth annual report of the Commonwealth Fund, which was established as a foundation "to do something for the welfare of mankind," during the year appropriated $2,277,953 for philanthropic purposes. More than four fifths of this amount was devoted to the promotion of physical and mental health, much the larger share going to medical education, medical research, public health and community hospitals in rural areas. Both the total appropriations and the percentage set apart for health purposes were the largest in the history of the fund, the endowment having been increased in 1937 to approximately $50,000,000.

Expressing his conviction that "some of the most important things that can not be done without money can not be done with money alone," the general director of the fund reported that in encouraging services to prevent disease and promote health, the fund "has demonstrated repeatedly that money will not create or maintain such services at optimum levels unless a great deal more than money is put into them. He writes:

> Foundations have learned that to spend money effectively for social ends it is necessary to invest judgment and technical skill, in generous quantity, in the choice of projects to be aided and in the evaluation of their results as a guide to further choices. They are fortunate in being able to focus relatively large amounts of technical skill on the study and sometimes the shaping of relatively small projects. They are particularly justified in doing so when the projects in question throw light on the

methods which must be used in attacking similar situations on a broader scale. What foundations have learned about the technique of making money work to buy health and other means of social progress may be useful in an era of great public spending.

STANDARDS FOR PHOTOGRAPHY

A START in the establishment of national standards for photography was taken on February 21 by a new committee, which met in the Engineering Societies Building, New York, and elected as its chairman Dr. Loyd A. Jones, of the Eastman Kodak Company. The committee was organized by the American Standards Association with the Optical Society of America taking the leadership in the technical work. Better interchangeability of parts and standards defining the performance of cameras, light meters, film, developing materials and photographic equipment is expected to result from work of this committee.

At the meeting plans were made to set up sub-committees which will cover physical dimensions of sensitive materials and holders; characteristics of sensitive materials; the finished photographic product; cameras, lenses, shutters, diaphragms, view finders, sizes and amounts of light filters, and dimensions of safe-lights; artificial illuminants; processing equipment, and projectors and printers.

The work of this committee is expected not only to result in national standards, but will also be the basis for American recommendations in connection with international standards for photography. An international committee on photography has already been authorized by the International Standards Association, with the American Standards Association, which holds the secretariat, taking the leadership in its work. The committee is also planning to work closely with the International Congress of Scientific and Applied Photography. The committee set March 24 as the date of its next meeting.

STUDENT AFFILIATE CHAPTERS OF THE AMERICAN CHEMICAL SOCIETY

STUDENT affiliate chapters of the American Chemical Society have been organized in sixteen colleges and universities. The society will hold its ninety-seventh meeting in Baltimore from April 3 to 7.

Membership in the chapters reaches 427, while another 145 affiliated undergraduates are scattered throughout twenty-three institutions in the United States and Hawaii. The total number of 572 comprises 181 seniors, 178 juniors, 148 sophomores, 58 freshmen and 7 special students.

Dr. Charles L. Parsons, secretary of the society, points out that it is evident that this newly organized method of procedure for interesting students in their own advancement is to become an important function bearing upon the development of the students in their professional consciousness.

The first group of student affiliates was formed at Lafayette College, under the auspices of the Lehigh Valley Section of the society. Other chapters have been established in Manhattan College, New York City; Rensselaer Polytechnic Institute; Union College, Schenectady, N. Y.; Rhode Island State College; Albright College, Pennsylvania; Virginia Polytechnic Institute; the University of Kentucky; the Rice Institute; Ohio Northern University; Central College, Missouri; the University of Minnesota; Hamline University; Colorado State College; the University of California, Berkeley, and the California Institute of Technology.

The Rice Institute Chapter, with 63 members, is the largest. The University of Kentucky and the University of California Chapters rank second and third with 52 and 51 members, respectively. Next come the California Institute of Technology, with 38 members, and Lafayette College, with 34 members.

Dr. John H. Nair, of the Borden Company, Syracuse, N. Y., is chairman of the Committee on Student Affiliates, which has supervised the organization of the student chapters, all of which are planning active programs in 1939. The society will sponsor an employment clearing house at the Baltimore convention, where student chemists will have an opportunity of meeting the personnel staffs of chemical industries. The announcement points out that "Personal contact is becoming more and more a prerequisite for employment. It will be a long time before employers cease going first to the colleges, especially those known to turn out the best trained chemists. This is particularly true for young men just out of college, since no one but the chemical departments of the colleges which they are leaving are able to give them any definite recommendation."

THE GEOLOGICAL SOCIETY OF AMERICA

THE Geological Society of America announces meetings for 1939 as follows:

The Geological Society will join with Section E of the American Association for the Advancement of Science in the summer meetings to be held in Milwaukee, from June 19 to 24. Plans for field trips are being made. Details of the scientific program and excursions will be announced in a later circular.

The council has authorized a joint meeting of the society with the Cordilleran Section, to be held at Berkeley, Calif., from August 8 to 10, followed by several field excursions. Fellows of the society are urged to take advantage of this opportunity and to lend encouragement by attending this meeting of the only section. Special facilities will be provided for visiting features of particular interest under the guidance of men intimately acquainted with local problems. It is understood that greatly reduced fares will be available on the transcontinental railways, and that local accommodations, both in Berkeley and on the excursions, will be provided at moderate cost. Plans should be made soon. A circular with more complete detail will be available shortly. Only one other meeting of somewhat similar character in the history of the society has been held in California. This was held at Berkeley and at Stanford University in August, 1915. One point of present interest in the record is the fact that the number of fellows attending was almost equally distributed between the Atlantic seaboard, the central region and the Pacific coast, with the advantage to the East coast. The Paleontological Society, the Seismological Society of America and the Society of Economic Geologists expect to meet in Berkeley at the same time.

Because of overlapping time, attention is called to the announcement of the Pan-Pacific Science Congress, which will hold meetings in the San Francisco Bay Region in July and August (Berkeley, from July 24 to August 5, and Stanford, from August 6 to 12). To avoid conflict no geological program will be arranged by the congress on August 8, 9 and 10, in order that those attending may participate in the Geological Society meetings. The excursions arranged for these meetings will also be made available to registrants of the Science Congress.

The Geological Society calls special attention also to the seventh triennial assembly of the International Union of Geodesy and Geophysics, which will be held in Washington, D. C., from September 4 to 15, under the auspices of the American Geophysical Union in cooperation with the National Research Council, and with support from other sources.

The council has accepted an invitation extended by the University of Minnesota, supported by local educational and scientific organizations, to hold the 1939 annual meeting in Minneapolis. The dates will be December 28, 29 and 30. This will be the first meeting of the society to be held in Minnesota, and the fifth held west of the Mississippi River.

Meetings of the council are regularly held in April and October and at the time of the annual meeting. Matters to come before the council should be in hand well in advance of these dates. It is expected that the April, 1939, council meeting will be held on the fifteenth of the month.

A series of addresses under the general theme "Frontiers of Geology" is being organized for broadcasting during March and April through the facilities of the National Broadcasting Company.

THE DIVISION OF THE BRITISH ASSOCIATION FOR THE SOCIAL AND INTERNATIONAL RELATIONS OF SCIENCE

IT is announced in the London *Times* that the Division for the Social and International Relations of Science, formed within the British Association last August, is arranging a program of meetings at which topics of immediate interest and importance will be discussed. The purpose of the division is to study the relationship between science and the community and to encourage the application of science to promote the well-being of society.

The first meeting will be held on March 28 at the University of Reading, by permission of the University Council and in cooperation with the National Institute for Research in Dairying, and two sessions will be devoted to discussion on milk in its nutritional and allied aspects. Sir Richard Gregory, chairman of the division, and Sir Daniel Hall will preside at the sessions, and other speakers will deal with deficiencies of diet, health aspects, pasteurization, production, cost, economic and social implications.

It is also proposed to arrange meetings in the early summer in London and Manchester for review of the social relationships of science and for discussion with special reference to pressing problems in industry and agriculture. In connection with the Manchester meeting, Professor H. Levy has been appointed to deliver the Alexander Pedler memorial lecture, in which he will explain the method of approach in the study of the social problems of science, with particular illustrations of the application of scientific discoveries to industry.

During the forthcoming meeting of the British Association in Dundee (August 30–September 6) the division will hold three sessions at which it is proposed to consider the coordination of scientific research, population movements and nutrition. Sir Richard Gregory will deliver an address on "Science and Social Ethics."

SCIENTIFIC NOTES AND NEWS

THE William Withering Lectures of the University of Birmingham will be given in late March by Dr. Peyton Rous, of the Rockefeller Institute for Medical Research. The subject will be "Present Aspects of the Cancer Problem."

DR. E. S. RUSSELL, director of research in the British Ministry of Agriculture and Fisheries, will give a series of five DeLamar Lectures at the School of Hygiene and Public Health of the Johns Hopkins University on successive days from March 20 to March 24. The subject will be "Fish Populations and the Effect of Fishing."

Professor August Krogh, of the University of Copenhagen, Nobel laureate in 1920, will deliver a series of lectures at Swarthmore College under the auspices of the Cooper Foundation, on March 16 and 23, and April 6, 13 and 20, at 8:15 P.M. The subject will be "The Comparative Physiology of Respiratory Mechanisms."

Masaryk University, Czecho-Slovakia, has conferred on Dr. Francis E. Lloyd, professor emeritus of botany, McGill University, the degree of doctor of science, *honoris causa*.

The honorary doctorate of the University of Greifswald has been conferred on Dr. V. F. K. Bjerknes, professor of physics at the University of Oslo.

M. Emmanuel de Margerie has been elected a member of the Section of Mineralogy of the Paris Academy of Sciences in succession to the late L. de Launay.

During the dedication ceremony incident to the opening of the new buildings of the Pasteur Institute at Garches, a suburb of Paris, the minister of public health conferred the rank of commander of the Legion of Honor on Professor Gaston Louis Ramon, director of the branch, in recognition of his work during the past fifteen years in immunology, especially the more recent contributions, such as vaccination against diphtheria and tetanus.

Professor W. H. Hoffmann, of the Finlay Institute, Habana, has been elected an honorary member of the Robert Koch Institute, Berlin.

The 1938 Lamme Medal of the American Institute of Electrical Engineers has been awarded to Marion A. Savage, designing engineer of the General Electric Company, "for able and original work in the development and improvement of mechanical construction and the efficiency of large high-speed turbine alternators." The medal and certificate will be presented to him at the annual summer convention of the institute, which is to be held in San Francisco from June 26 to 30.

A bronze bust of Professor Fred Conrad Koch, chairman of the department of biochemistry at the University of Chicago, was presented to the university on February 8 by a group of alumni and friends. At the unveiling ceremony, the speakers were Dr. Howard M. Sheaff, a 1919 Ph.D. from the department, and President Robert Maynard Hutchins. The bust is mounted in the lecture room of the Biochemistry Building and is a companion to the bust of Professor A. P. Mathews, first chairman of the department.

At the opening clinic for a six weeks graduate course in medicine sponsored by the Medical School and the Extension Division of the University of North Carolina, a luncheon was given in honor of Dr. Alfred Stengel, vice-president for medical affairs at the University of Pennsylvania.

At the annual election of the California Academy of Sciences held on February 15 the following officers were elected: *President,* Dr. F. M. MacFarland; *1st Vice-president,* The Hon. Herbert Hoover; *2nd Vice-president,* Dr. E. P. Meinecke; *Recording Secretary,* Dr. Olaf P. Jenkins; *Corresponding Secretary,* Dr. Charles L. Camp; *Treasurer,* Francis P. Farquhar; *Trustee for five-year term,* Mrs. Alexander F. Morrison.

Dr. Max Jennings Plice has been appointed associate professor of agronomy at the University of Oklahoma, and Dr. Michel Afanasiev, associate professor of horticulture. Other appointments include the following assistant professors: Dr. Gladys Marie Kinsman in home economics research, Dr. William Winfield Ray in botany and plant pathology and J. Lee Brown in horticulture.

Dr. W. M. Beeson, assistant professor and assistant in animal husbandry in the University of Arizona, has returned to the University of Idaho as associate professor of animal husbandry, in charge of animal nutrition and judging.

Dr. Arthur L. Benton, of the New York Hospital and the department of psychiatry, Cornell University Medical College, has been appointed instructor in the personnel bureau of the City College of the College of the City of New York.

Dr. Harold C. Bryant, who has been assistant director in Washington of the National Park Service, in charge of the Branch of Research and Information, has been transferred to Grand Canyon National Park as acting superintendent.

Bradford Washburn, of Cambridge, geographer and explorer, has been appointed executive director of the New England Museum of Natural History. Dr. Edward Wigglesworth will remain as scientific director.

Dr. Waldo G. Leland, secretary of the American Council of Learned Societies, recently became a member of the committee of the National Resources Committee to study the relations of the Federal Government to scientific research.

M. N. Shaffner, of the Pennsylvania Topographic and Geologic Survey, will serve as secretary-treasurer of the Field Conference of Pennsylvania Geologists, to succeed Dr. Arthur B. Cleaves, who recently left the survey.

Lincoln Ellsworth plans an expedition into the Antarctic in 1941, during which he proposes to camp for the entire winter at the South Pole with "not more than two companions, to carry on continuous observations of importance in several branches of scientific research."

DR. GEORGE H. H. TATE, assistant curator of South American mammals of the American Museum of Natural History, sailed on February 23 for Paris to arrange for an expedition to the Ivory Coast of Africa to collect chimpanzees and mandrill monkeys for habitat groups in the museum. He will be joined in Paris by Robert Kane, of the department of arts and preparation, who has been in East Africa for the last year.

DR. L. C. GRATON, professor of mining geology at Harvard University, has returned from a journey of eight months to islands and bordering countries of the South Pacific, where he investigated volcanoes, hot springs and fumaroles from the aspect of their connection with the origin of deep-seated ore deposits. He was invited to address scientific audiences in Honolulu, Hawaii; Nouméa, New Caledonia; Sydney, Australia, and Baguio, Philippines.

PROFESSOR K. LINDERSTRØM-LANG, of the Carlsberg Laboratory, Copenhagen, will deliver the sixth Harvey Society Lecture of the current series at the New York Academy of Medicine on March 16. He will speak on "Distribution of Enzymes in Tissue and Cells" Dr. Linderstrøm-Lang will also give at Harvard University the Edward K. Dunham Lectures for the current academic year.

DR. CHARLES H. BEST, professor of physiology and associate director of the Connaught Laboratories of the University of Toronto, gave a lecture on "Heparin and Thrombosis" on March 8 before the Yale Medical Society.

THE Pennsylvania State College is celebrating the two hundred and sixth anniversary of the birth of Joseph Priestley with the presentation of the thirteenth annual series of Priestley Lectures on March 20 to 24. The lectures, a series of five, will be given each evening at 7:30 P.M. by Dr. Kenneth S. Cole, associate professor of physiology at the College of Physicians and Surgeons, Columbia University. He will discuss the interrelationships between physical chemistry and cell membranes.

THE Section of Physics and Chemistry of the New York Academy of Sciences sponsored a conference on kinetics in solution on February 24 and 25, 1939, under the chairmanship of Professor Victor K. LaMer, Columbia University. The speakers included Professors Henry Eyring, Princeton University; J. C. Warner, the Carnegie Institute of Technology; S. H. Maron, the Case School of Applied Science; P. D. Bartlett, Harvard University; L. P. Hammett, Columbia University, and Drs. Irving Roberts, Columbia University, and F. H. Westheimer, Chicago.

THE fiftieth anniversary of the foundation of the Pasteur Institute of Paris will be commemorated on March 15, when it will be presided over by the President of the French Republic.

THE biennial assembly of the International College of Surgeons will be held in New York at the Hotel Roosevelt from May 21 to 24, under the presidency of Dr. Andre Crotti, of Columbus, Ohio.

AN International Congress on Magnetism will be held in Strasbourg from May 21 to May 25, under the auspices of the International Institute of Intellectual Cooperation and the Service Central de la Recherche scientifique de France. Fifteen reports will be presented on paramagnetism, ferromagnetism and magneto-optics. The American representatives to the congress are Professor J. H. Van Vleck, of Harvard University, and Professor S. J. Barnett, of the University of California.

THE fifth International Congress for the Unity of Science will be held at Harvard University from September 5 to 10. The subject of the congress is "The Logic of Science." Information in regard to it can be obtained from Professor C. W. Morris, University of Chicago

IN accordance with the results of a poll recently taken of the membership of the American Society of Zoologists, the 1939 annual meeting of the society will be held next December in Columbus, Ohio, in conjunction with the meeting of the American Association for the Advancement of Science.

THE Association of Southeastern Biologists will hold its annual meeting on April 14 and 15 at Duke University. Titles and abstracts of papers should be sent to Donald C. Boughton, Secretary-Treasurer, University of Georgia, Athens, before March 15.

A BIOPHYSICS symposium will be held in connection with the annual meeting of the Southeastern Section of the American Physical Society at the University of Georgia, on March 31 and April 1. Dr. Detlev W. Bronk, director of the Johnson Foundation for Medical Physics of the University of Pennsylvania, has been invited to give a paper on "The Physical Basis of Biological Organization." A series of shorter invited papers also included on the program are: "Applications of Nuclear Physics to Biology," J. B. Fisk, University of North Carolina; "The Present Status of the Electron Microscope," Otto Stuhlman, Jr., University of North Carolina; "Applications of Photography to Medical and Biophysical Problems," Gilford G. Quarles, University of Alabama; "Purification of Biological Materials by Centrifuging," J. W. Beams, University of Virginia. In addition there will be a program of contributed papers. Dr. Clyde B. Crawley, University of Alabama, is chairman of the Biophysics Symposium

THE 1939 annual summer term of the American School of Prehistoric Research will open in Paris on July 1 and close in France on September 9. The tentative program includes laboratory work and visits to the museums in Paris and Saint-Germain-en-Laye; visits to the principal museums and excursions to important prehistoric sites in various parts of France, and practice in excavating at two or more sites. The Abbé H. Breuil, an authority on Old World prehistory, will be in charge of the course, assisted by Harper Kelley, a former student of the school. They will have the cooperation of various French specialists. Prospective students should apply for enrolment as soon as possible. Applications for enrolment and for further information should be addressed to George Grant MacCurdy, director, American School of Prehistoric Research, Old Lyme, Conn.

WE are requested to state that all reprints of the work of the late Professor George Barger have been deposited in the department of chemistry of the University of Glasgow, and that copies can be obtained by application to the secretary of that department.

THE Office National des Universités et Ecole Françaises has offered a graduate fellowship of 18,000 francs for the study of science at a French university. Two fellowships of a similar amount are being offered for study in Paris by the Société des Amis de l'Université de Paris; one for a graduate student to undertake scientific research and one for a graduate student specializing in the study of international relations. Application blanks may be secured from the Institute of International Education at 2 West 45th Street, New York City. The closing date for filing applications with complete credentials is April 1.

A GIFT of $100,000 has been made by Bertram J. Cahn, of Chicago, toward the fund being raised by Northwestern University for the erection of Scott Hall, as a tribute to President Walter Dill Scott, who will retire next autumn to become president emeritus. The sum of $200,000 has been given for the Hall by the Woman's Building Association of the University Guild and the sum of $85,500 has been received from various sources.

DISCUSSION

MICROFILM COPYING OF SCIENTIFIC LITERATURE

SCIENTIFIC research may in certain rare cases be pursued for personal gain, but its publication is practically always solely for the benefit of others. The real problem is to insure its widest possible dissemination to those best able to make use of it for the advancement of science.

By far the largest part of scientific research is published under the auspices of institutions, societies, associations, governmental agencies, academies or other organizations having for their object either the advancement of learning or the industrial applications of scientific discoveries. The supplementary diffusion of scientific literature by means of microfilms is, accordingly, in entire accord with the aims of those who are principally responsible for its publication.

There are, however, a small number of scientific periodicals which are published by private initiative, and some of these are copyrighted or prescribe restrictions in regard to copying their contents. It is this relatively small number of journals which give rise to the question as to the legality of microfilm copying of scientific periodicals.

In the case of these, as with research periodicals in general, the contributors are very rarely paid and of course do not participate in the profits, if any, derived from their publication. It may, therefore, be asked whether it is the contributors or the publishers who are entitled to the protection afforded by copyright It is evident that the contributors do not desire such protection and it is certainly rarely possible for the publishers to benefit from it. It is, therefore, not clear why any publication of scientific research is ever copyrighted.

Although it was believed that a very small proportion of scientific periodicals are copyrighted it was decided to make a survey to ascertain approximately what proportion are so protected For this purpose 101 periodicals received in the field of biological and agricultural chemistry in the library of the Pasteur Institute of Paris were examined, and only 15 found to bear the copyright mark or make any reservation in regard to copying their contents. Of the latter several prohibited complete or partial reproduction except by authorization. It is probable that many of the copyrighted ones would also grant permission for microfilm copying if requested. It may be concluded, therefore, that the proportion of current scientific periodicals restricted in regard to microfilm copying is very small.

In this connection it may be mentioned that Bibliofilm Service has been operating in the library of the U. S. Department of Agriculture for four years and has now attained a monthly distribution of more than 20,000 pages of scientific literature copied from several hundred periodicals, for more than a thousand research workers in the United States and elsewhere, and has never had a complaint of copyright infringement. This may be considered good evidence that in so far as scientific literature is concerned, the limitations of microfilm copying imposed by copyright is negligible.

There is, however, another angle of the subject which has been suggested as of perhaps greater importance than the legal aspect. That is, the effect which the general distribution of the material printed in current journals may have upon their circulation. It can not be denied that certain ones, devoted to narrow fields of learning, do have great difficulty in securing and earning the support necessary for their existence. In these cases it is possible that some individuals and even libraries would not subscribe to them, if the papers they contained could be obtained in the form of microfilms for less than the cost of the subscripiton. These, therefore, might be damaged by unrestricted microfilm copying.

This situation, however, raises the question whether the printing of journals which fail to command sufficient support to pay their way is economically justified. There is little doubt that the present system of publishing certain very highly specialized research is extremely wasteful. In the case of journals of interest to a very limited number of workers the expense and effort necessary for their editing, printing, distributing, cataloging and conserving in libraries should be weighed against the advantage to the small group of persons capable of making use of them. Of course if publication by printing was the only means by which the results of highly specialized research could be brought to the attention of persons capable of making use of it for the advancement of science, there would be no question of paying the cost, no matter how great. Fortunately, however, the development of microfilms has introduced a far simpler and more economical plan of distributing such reports to other workers. This is by what has come to be known as auxiliary publication. By it, the author publishes in the widely circulating printed journals only such details of his work as are necessary to acquaint others with its scope and conclusions. He prepares for an authorized depository a detailed description of his experiments, accompanied by tables, charts, illustrations or anything else needed to convey to others a thorough comprehension of his work. This complete report serves for the preparation of microfilm copies which are given an identifying number corresponding to the number which accompanies the printed summary of the work. Those who read this brief account in the widely circulated journal and desire the complete paper simply order a microfilm copy of it by number from the authorized depository at a very modest price. Only the number of microfilm copies that are ordered are made, and only one repository is charged with keeping the original paper. Thus the cost of printing, distributing and conserving in libraries voluminous detailed reports of research, of interest to only few workers, is completely avoided.

This plan of publication also has another very important advantage. The rising costs of printing and increasing number of papers submitted have forced the publishers of practically all scientific periodicals to insist on the greatest possible condensation of the papers they print. This results in the publication of many papers in such an abbreviated form that their value to others is diminished. Auxiliary publication by microfilm distribution avoids this and insures that the work of every investigator is brought in its most complete form only to those investigators who are able to make best use of it.

From the above it follows that even though microfilm copying may adversely affect the publication of certain small numbers of highly specialized journals it provides a substitute plan for the diffusion of scientific research which is far superior and much more economical than the system of publication solely by printing.

Finally, attention should be called to the fact that library collections contain not only current periodicals the contents of which are subject to greater diffusion by the medium of microfilms, but the accumulated mass of scientific literature over many years which microfilms can also place at the disposition of those workers not having access to such collections. Thus, the question of copyright restriction and possible adverse effect of microfilm copying upon a relatively few journals should have little weight in appraising the tremendous service which microfilm copying in libraries can contribute to the advancement of learning.

ATHERTON SEIDELL
NATIONAL INSTITUTE OF HEALTH
WASHINGTON, D. C.

AN EASIER METHOD FOR MAKING AN INDEX

"AN easy method for making an index," described in the issue of SCIENCE for January 20, involves cutting innumerable strips, handling slips of varying sizes which would be awkward to alphabetize, working with adhesive tape and typing twice. Sticking the entries on 11-inch tape would hamper editing, cross-referencing and possible transfer of material from one heading to another, all of which has to be done after the alphabetizing has been completed. Thus it appears that indexing by the proposed method would consume more time than it would save. When the work is done by the usual one-card-per-entry method there is but one typing, alphabetizing is easily done, there is no messing with tape or time-consuming cutting, and the easily numbered cards can be readily bundled and sent to the printer. No typing on sheets is necessary.

If even a quicker method is desired the following is suggested: Use typewriter paper on which perforations divide each sheet into ten sections. Or, better still, use rolls of paper 4 inches or 5 inches wide, with perforations 3 inches apart. Type one entry on each section, and when the index is completed tear the sections apart and arrange the slips alphabetically. These slips are a handy working size, can readily be edited and rearranged, and then may be sent directly to the printer. This method avoids putting a card or slip into the typewriter and taking it out for each entry.

MABEL HUNT DOYLE
MARY A. BRADLEY

INDEXING SECTION
DIVISION OF PUBLICATIONS
UNITED STATES DEPARTMENT OF AGRICULTURE

EVIDENCES OF A PRE-CERAMIC CULTURAL HORIZON IN SMITH COUNTY, KANSAS

A CULTURAL horizon, buried some ten feet or more below the top of a twenty-one foot terrace along the banks of a small intermittent stream in Smith County, Kansas, has been under investigation by a University of Kansas field party under the direction of Dr. L. C. Eiseley, assistant professor of sociology and anthropology at the latter institution. The archeological material recovered consists of numerous flakes and rejects, a few scrapers and a single point. The material is intermixed with the charred and fossilized remains of bison and other animals. Although the material suggests more than a casual occupation of the site, no evidences of pottery or agriculture were secured.

According to Dr. H. T. U. Smith, assistant professor of geology at the University of Kansas, who conducted geological investigations at the site, the geomorphic changes which have taken place involve the following stages: First, a deposition of over ten feet of alluvium above the site; second, a lowering of the local base level and the formation of a flood plain fourteen feet below the top of the fill; third, a second lowering of base level and the development of a new flood plain twenty-one feet below the top of the original fill. This flood plain has a width of a hundred yards and is entering middle maturity. The geological evidence suggests that these changes could not have taken place much under a minimum of five thousand years ago, and the site may actually be older.

Inasmuch as the point recovered is not Folsom, but a well-worked artifact of a size suggesting its use with the bow, and as, in addition, there is no reason to refer the bison remains recovered to an extinct species, it seems reasonable to assign the site a dating later than the Folsom culture, but predating by a considerable margin the appearance of agriculture in the central plains. The importance of the site lies in its contribution of additional evidence of the existence of nomadic bison hunters in the central plains below the recognized ceramic cultures, but evidently later in time than the Folsom horizon, judging both from the probable use of the bow and the associated remains of a living species of bison. At the same time, because of its genuine geological antiquity, the site is an added check on the postglacial, early Recent fauna associated with man in the Plains region.

LOREN C. EISELEY

SCIENTIFIC BOOKS

TRAVELS OF A PLANT EXPLORER

The World was my Garden. Travels of a Plant Explorer. By DAVID FAIRCHILD, assisted by ELIZABETH and ALFRED KAY. Chas. Scribner's Sons, New York and London. Pp. 494. Many illustrations. 1938.

A MORE charming and interesting autobiography could scarcely be imagined. Fairchild is not known to the world from any great discovery or generalization, such as those of Darwin, Mendel and the Curies; but taken all together, his contributions to horticulture and thus to human welfare have been so great that he deserves to rank with those who have done most for their country and the world. The present book, giving a connected account of his activities, is especially valuable as showing what has been done, not only by Fairchild but also by those who cooperated with him, to all of whom full and generous credit is given. The results of all this work may be found in every part of the United States, where introduced plants are growing and producing increasingly valuable crops. It would be impossible to estimate the value of the products which have been made available to us through Fairchild, or to say what limit there may be to their increasing value, as they become better known, and the conditions of their cultivation better understood.

How are such men produced? Fairchild says:

> Going back through the mists of sixty-odd years, I realize that I both had the suitable heredity and was born into an environment adapted to the development of a naturalist or horticulturist. In other words, my path was almost predestined at my birth. I do not believe that I consciously chose its direction, but rather wandered down its attractive way unconscious where I was going. . . . Had I the choice of a place to be born, a family to be born into, and an environment with which to surround myself, I could hardly have chosen more wisely than Fate chose for me in 1869 when I was born at Michigan State College. My parents belonged to the class to whom the intellectual future of this country meant more than anything

else in the world. As a boy, I heard countless discussions in my father's house concerning some of the most fundamental changes which have taken place in the education of the youth of America; discussions among pioneers who have left their mark on much that is fine and splendid in the civilization of our country.

When he was ten years old, the family moved to Manhattan, Kansas, his father having been made president of the then small agricultural college. Here, as he grew up, he was fortunate in coming under the influence of some active-minded men, who were concerned with the practical problems of the farmers. He early appreciated the nature of these problems and the fact that they had to be solved by scientific research. It was the beginning of many things, and, says Fairchild: "We were all to be actors and supers in a gigantic drama. Its importance has meant little to the press, which sees news only in the startling headlines of the day, but I believe that history will evaluate our work more highly, for historians view life in terms of related instead of unrelated days."

In 1889 he was invited by B. T. Galloway to go to Washington, to serve in the Department of Agriculture, with a salary of a thousand dollars a year. It was not a very attractive prospect, and there was some hesitation about accepting, but as a matter of fact it opened a broad way to new opportunities, and was the foundation for the work to which he devoted his life. Although the department in those days was poorly housed and appeared to be a rather insignificant branch of the government service, it included a group of very remarkable men, who are now famous in the annals of science. One wonders how they got there, and how much was due to their native ability, how much to the fact that they were pioneers in important fields just then beginning to be cultivated in this country. It was indeed a wonderful opportunity; the broad continent of North America, with all its different conditions of soil and climate, so rich in its possibilities, so poorly developed in comparison to what might easily be. No doubt in some directions the prospects appeared brighter than they actually were, the many difficulties not being fully appreciated, but the resulting optimism did no harm, and the outcome has been a very notable enrichment of our standard of living.

Broadly speaking, the problem for agriculture and horticulture was to find the crops which it was most profitable to grow in each locality. It was not purely a question of making money for the farmer, but also of serving the public. Whether or not the crops produced more income, it was worth a good deal to have interesting and diversified foods on the market. In different parts of the world, from very early times, people had striven to improve their crops, or had selected those they preferred. Sometimes nature had done the selection, as by the survival of hardy varieties in a cold climate, or of resistant varieties in the presence of parasites. Some of these variously improved varieties had been introduced into the United States, with very excellent results, but the world had never been systematically explored for them.

So any one might have reasoned, but what could be done about it? Certainly the American government had no idea of initiating such a great enterprise. Fairchild, now fairly launched as a scientific worker, did not yet see himself as a botanical explorer. He wished to go to Europe to increase his scientific knowledge, and the opportunity came when Dr. Stiles got him appointed to the Smithsonian table at the Naples Zoological Station. The voyage across the Atlantic was very stormy, "the roughest and most uncomfortable of my life." "One morning I was amazed to see a man standing in the doorway of the second officer's cabin, clad in wrapper and pajamas. It was the first pair of pajamas I had ever beheld; heretofore every one I had seen attired for slumber had worn a nightshirt. Somewhat stunned, I stared at this tall stranger in open-mouthed astonishment. . . . He was very good looking, standing there in the sunlight, quite the distinguished man of the world." This was Barbour Lathrop, who nicknamed Fairchild "Fairy," but was himself the good fairy who directed his destiny and made his great work possible. When Fairchild got acquainted with Lathrop, he told him about his various ambitions, and especially how he longed to go to Java, but of course could not stand the expense. When Fairchild had been at Naples about a month, Lathrop turned up, along with Professor Raphael Pumpelly, of Cambridge, Massachusetts. Lathrop wanted to see what Fairchild was doing, but was not much interested in karyokinesis. So he said: "You told me on the boat that you wanted to go to Java. Have you given up that idea?" Presently he added: "I've decided to give you a thousand dollars with which to go to Java. I want you to understand that I look upon this thousand dollars as an investment, nothing more. I have had you looked up, and you seem to be all right, and when you are ready for the money I will send you a letter of credit for that amount."

One might suppose that Fairchild would have taken the next boat for Java, but he explained to Mr. Lathrop that he thought he should continue his training in Europe, so as to become better fitted to justify the "investment." So we find him at Breslau, Berlin and Bonn, and there is much to tell of his experiences there.

But "every few months a letter would reach me from Mr. Lathrop asking why the devil I had not gone to Java." Eventually, in 1896, the great day came, and Fairchild sailed for Java "under Dr. Treub's chaperonage." In his work at Buitenzorg, he specialized in the natural history of termites, finding out some very interesting facts. Perhaps he would have become a noted entomologist, following the methods of his friend, W. M. Wheeler, had not Mr. Lathrop again interfered. The next chapter is headed "The Lathrop-Fairchild Odyssey Begins." Mr. Lathrop carried him off, and one fateful night as the vessel lay off the Island of Penang, the two men had an earnest conversation, at the end of which "I had promised Mr. Lathrop that I would take up a study of the plants useful to man, and together with him, find a way to introduce their culture into America. It was a rather vague, ill-defined agreement, but it was a turning point."

We now find the two men spending many years going up and down the world, exploring for useful plants. Mr. Lathrop had no particular interest in scientific research as such, and apparently did not even care much for ornamental plants, but no expense or trouble seemed too great if it resulted in securing some plant valuable as food or for some commercial product One would like to review all these adventures in some detail, but they must be left for readers of the book. Mr. Lathrop was not always easy to get along with, and had an impatient temperament, so that he often wanted to leave a place at the very time when Fairchild thought it most profitable to stay. But whatever his faults, he was a constant friend and supporter, and without him, many splendid opportunities would have been missed. On the other hand, we must recognize that in Fairchild Lathrop found an extraordinary treasure, and it is greatly to his credit that he so readily appreciated this fact. The book is written in a modest vein, but we are amazed at the energy, enterprise and resourcefulness exhibited, and the ability to enlist the aid and interest of all sorts of people in many countries. The narrative is full of side-lights on the people and countries visited; thus, for example, in Egypt he visited the palace of Queen Hatshepset (1570 B.C.) where he found a bas-relief representing the introduction of the incense tree from the land of Punt. "A warm feeling of understanding surged through me for this woman who, like myself, appreciated the value and romance of plant introduction. Here on the walls of her palace in Thebes, she had commanded a bas-relief to be cut commemorating her importation of a new tree into her domain. It was quite thrilling, for, as far as I know, there are not a half dozen memorials commemorating the introduction of new plants."

At length Fairchild returned to Washington, to superintend the now great enterprise which had grown up, largely through his activities. "I had expected to find it difficult to settle down to a desk in Washington, but on the contrary it proved so fascinating that there were not hours enough in the days or nights in which to accomplish all there was to do. Beside each day's mail, and routine, and reports on my travels to be written for future reference, there was the world-wide field of plants still waiting to be introduced."

On one occasion, he was invited to a dinner party. "It was a small party, and I found myself seated beside Miss Marian Bell, who had recently returned from New York, where she had been working in the studio of Gutzon Borglum. Our conversation was largely on art, about which I knew nothing but could talk a good deal, having traveled with Mr. Lathrop, who was a real connoisseur. It was the first chance I had to talk to Miss Bell, and I was fascinated by her. . . . I left the house, my mind in a whirl, a whirl which has really never stopped since. It was the beginning of a part of my life which has been completely different and vastly more beautiful than anything I had dreamed possible."

Thus he became a son-in-law of Alexander Graham Bell. Of these later happy years, not yet finished, much might be said, but I hope I have written enough to arouse some of the enthusiasm which should greet such a stimulating book.

T. D. A. COCKERELL

UNIVERSITY OF COLORADO

REPORTS

PILOT FITNESS FOR NIGHT FLYING[1]

A LIGHT sense tester correct in principle and convenient for use is an important instrument for testing pilot fitness for night flying.

Important functions to be tested are: (a) the ability to see at night and at low illumination and the effect of dark adaptation on this ability, and (b) the amount and speed of dark adaptation. Normal or better-than-normal sensitivity in light adaptation is also important. The eyes that are needed for night flying are the best of what might be called the normal group; that is, of those that have both good dark and good light vision. More important than speed and range of adaptation, however, is the place in the scale of sensitivity at which the adaptive change occurs. Some eyes have a good range and speed of adaptation, but the adaptive change begins so low in the scale of sensitivity that they never attain the degree of sensitivity that gives the special fitness needed for night flying.

The ability to see at night and at low illumination

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[1] From the Research Laboratory of Physiological Optics, Baltimore, Md.

and the effect of dark adaptation on this ability. In general, the ability to see at low illumination may be tested by determining the threshold of light sensation, or what is often called the light minimum. The effect of dark adaptation on this ability may be tested by determining the light minimum at the intervals selected for consideration from the beginning of dark adaptation until the process is complete. The results of these determinations when plotted against time in the form of a curve give a complete picture of the course of adaptation of the eye in question throughout a period of time. Thus one can obtain the eye's sensitivity at any time from the beginning to the end of dark adaptation. Whether one or a number of these intervals is chosen for test depends on the purpose for which the test is being made. If the eye's maximum sensitivity is wanted approximately, for example, the test should be made at the end of an interval of 20 or 30 minutes.[2]

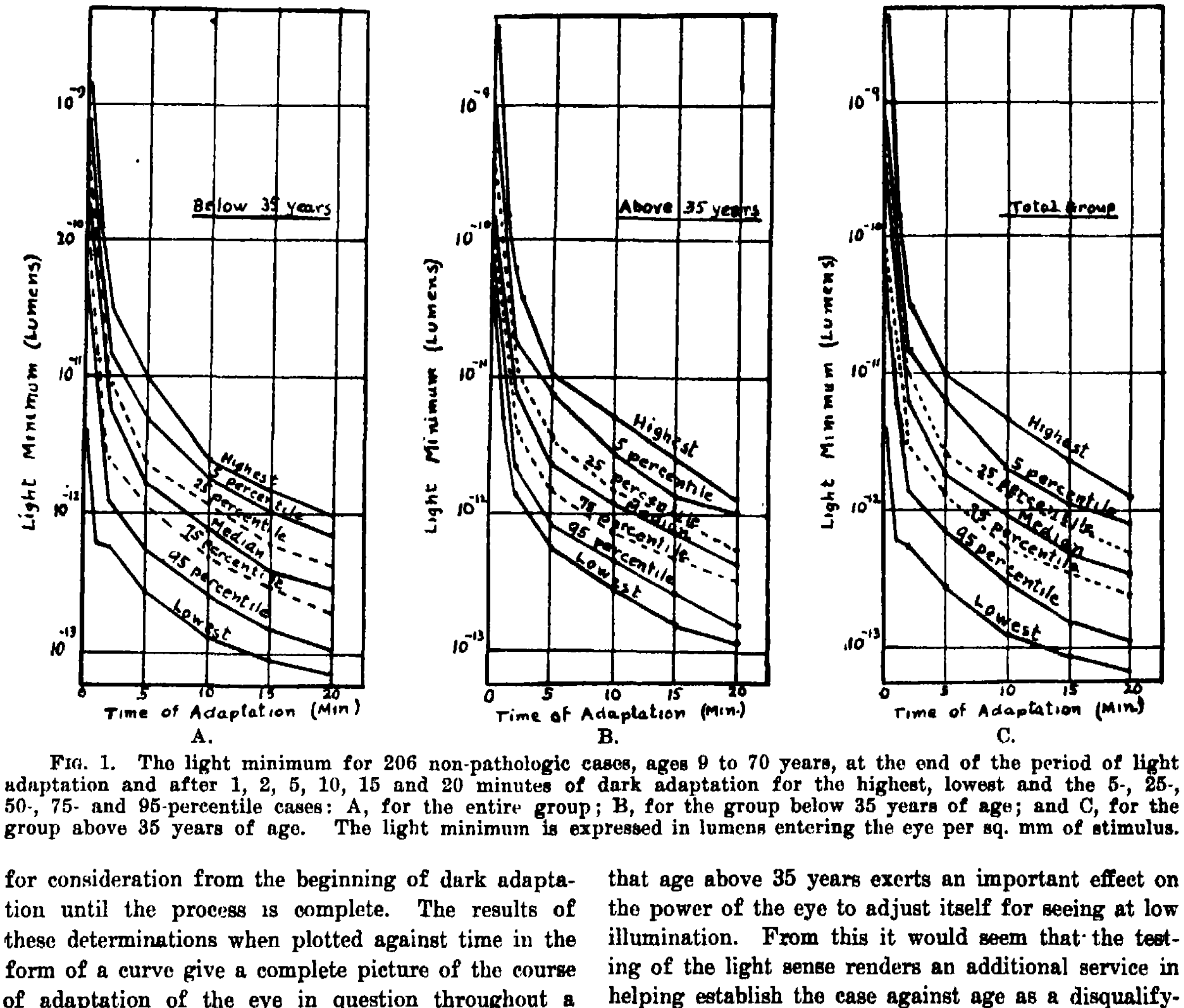

FIG. 1. The light minimum for 206 non-pathologic cases, ages 9 to 70 years, at the end of the period of light adaptation and after 1, 2, 5, 10, 15 and 20 minutes of dark adaptation for the highest, lowest and the 5-, 25-, 50-, 75- and 95-percentile cases: A, for the entire group; B, for the group below 35 years of age; and C, for the group above 35 years of age. The light minimum is expressed in lumens entering the eye per sq. mm of stimulus.

In order to show the amount of individual variation that may be found in the ability to sense light at different intervals in the course of dark adaptation, a study was made of 206 non-pathologic cases ranging in age from 9 to 70 years.[3] The results of this study are given in Fig. 1. The curves in Fig. 1 show also that age above 35 years exerts an important effect on the power of the eye to adjust itself for seeing at low illumination. From this it would seem that the testing of the light sense renders an additional service in helping establish the case against age as a disqualifying factor for night flying and of presenting evidence against those who wish to continue in this capacity beyond their time of fitness.

THE AMOUNT AND SPEED OF DARK ADAPTATION

Those intimately conversant with the ocular needs of the night flyer say that speed is more important than total amount or range of adaptation. That is, what the night flyer needs more than anything else is the power to change his vision quickly from the illuminated cockpit and instrument panel to the outside world and back again. In this connection it may be noted that the transition from outside back to the cockpit does not present so serious a problem because light adaptation takes place with very much greater rapidity than dark adaptation. What problem there is comes from the fact that until sufficient light adaptation has taken place a disturbing dazzle may be present. In most cases at medium intensities this effect will disappear in a few seconds. If found necessary, a test for this can easily be devised. However, in relation to fitness for night flying it is perhaps well to point out again that neither speed nor amount of change in sensitivity is as important as place in the scale of sensitivity at which the adaptive change occurs. That is, it is quite possible that a candidate might have a good range and speed of adaptation and still a comparatively poor power to see at low illumination both at the beginning and at the end of dark adaptation. Such a person would obviously be unfit for night flying. The night flyer should have normal or better-than-normal ability to see objects the instant he looks from the cockpit to the outside world, as well as normal or better-than-normal power to increase this ability as dark adaptation is prolonged. The point should be tested, not assumed; that is, the test should be made at the beginning as well as at the end of the period of adaptation selected.

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[2] The determination of the light minimum for the discrimination of detail in objects may also be used as a test of ocular fitness for night flying. That test, however, will not be considered in this paper. Depending on the size of detail that is used, the test may be made for either foveal or extrafoveal vision. In this connection it may be noted that the adaptive change in the fovea has a very much smaller range than in the surrounding portions of the retina and that the greater number of objects which it is important that the aviator see are extrafoveal in size. Both intrafoveal and extrafoveal sizes of test object are doubtless needed for a complete study of the eye's fitness for night flying. So far as we know, it has not been determined whether in all cases candidates will be given the same ranking in a group when tested for foveal and extrafoveal powers of adaptation.

[3] For the details of this study see C. E. Ferree, G. Rand and M. R. Stoll, *British Jour. Ophthal.*, 18: 673–687, 1934.

For testing the amount or range of adaptation the light minimum can be determined at the beginning of dark adaptation and at the end of some interval of suitable length, preferably 20 or 30 minutes for the approximate total range. A good conception of the amount of adaptation that may be expected in a group of non-pathologic observers may be obtained by inspecting the curves of Fig. 1; also a fairly good conception of the range of individual variation in this amount, although these curves were not plotted specifically to bring out this point.

For testing speed of adaptation obviously many possibilities are presented. These will be discussed in detail in other papers. In this paper we shall limit ourselves to the suggestion of a routine procedure that will give information on all the essential points noted above as important in rating fitness for night flying.

The instrument recommended for these determinations is the Ferree-Rand Light Sense Tester in the simplified form manufactured by the Bausch and Lomb Optical Company (Fig. 2). This instrument possesses many unusual features which render it easy and convenient to make accurate studies of the light sense and the effect of dark adaptation on the light sense. Some of these are: (a) All variable effects due to size of pupil, also as far as is possible to accommodation, distance of projection of the image and condition of refraction are eliminated from the results. (b) For the determination of amount and rate of adaptation a pre-exposure field variable in size is provided, surrounding and including the test field. (c) The test field may be quickly varied in size through a visual angle ranging from near zero to 36 degrees and given any shape that is desired. (d) A scale is provided indicating the amount of light entering the eye expressed in lumens per sq. mm. of test field. (e) The instrument can be used with equal facility in any state of adaptation, light or dark, and all adjustments can be made without interfering with the state of adaptation of the observer. Further, all scales can be read by the examiner in the dark. (f) The instrument is completely self-contained, neat and compact in construction and conveniently portable. (g) Provisions are also made for producing a wide range of intensity of light in both pre-exposure and test fields without change in the color or composition of the light, for making an objective check on the judgment and for checking the constancy of the amount of light delivered at the pupillary aperture of the instrument for any given reading of the scale.

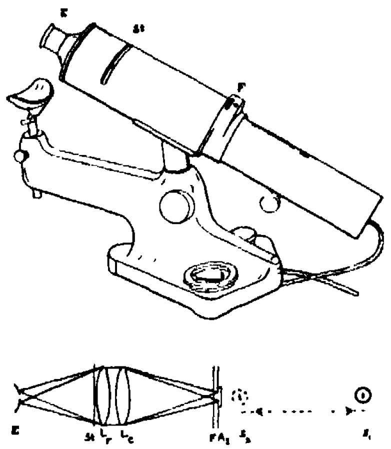

FIG. 2. Simplified light sense tester with diagram of its optical system. S_1, source of light in far position; S_2, source of light in near position; A_1, intake aperture with diffuser; F, battery of filters; L_C, collimating lens; L_F, focusing lens; S^t, plate containing stimulus aperture; E, eyepiece.

The test should be made as follows. After a suitable period of adaptation, perhaps 3 to 5 minutes, to the pre-exposure field of the instrument, the light minimum should be determined and then redetermined after 2, 3 or 5 minutes of dark adaptation as may be desired. From the results obtained, the sensitivity of the light-adapted eye may be derived, the rate of gain in sensitivity for a given period of dark adaptation, and the sensitivity at the end of this period. This would seem to give the most important information needed; namely, the light sensitivity of the light-adapted eye, the sensitivity that may be attained after a selected period of dark adaptation and the speed of dark adaptation. This information would enable the examiner to exclude eyes defective in power to see at low illumination when either light-adapted or dark-adapted (hemeralopia, avitaminosis, etc.) and to select the best of the normal eyes.

In our thinking as to the comparative importance of pilot fitness as a safety factor in aviation, it is well to keep in mind a statement made by Major-General James E. Fechet (Ret.), formerly chief of the U. S. Army Air Corps.[4] Discussing the causes of airplane crashes, he says that in more than half the number of cases these crashes are due to personnel error or to undetermined causes. In the personnel group he includes the pilot, the weather man, the airline operations manager and the mechanic. A small per cent. of these crashes—less than five, he says—is due to mechanical failure—engine malfunctions, breakage of some part of the plane or its essential accessories. From this it seems that not the plane but its operation is chiefly at fault.

C. E. Ferree
G. Rand

SPECIAL ARTICLES

HUMAN TOXOPLASMOSIS: OCCURRENCE IN INFANTS AS AN ENCEPHALOMYELITIS VERIFICATION BY TRANSMISSION TO ANIMALS*

A PROTOZOAN encephalomyelitis in infants, described in recent years,[1,2] has been experimentally transmitted to animals and shown to be due to a Toxoplasma. The latter is a Protozoan which in smears appears of crescentic shape, measures 4–6 microns in length and 2–3 microns in width. It is pointed at both ends or has one blunt end and has a central chromatin body. Although it is of uncertain classification, it is characterized by an affinity for many tissues, especially the central nervous system, wide-spread geographic distribution and pathogenicity for a wide variety of hosts. In spite of the last, human infection has not hitherto been established, one report being very doubtful.[3] Its occurrence is now proved by the recent transmission of the infection to animals from an infant.

The child became ill at three days of age and developed convulsive seizures, disturbances in respiration and symptoms of involvement of the spinal cord. Terminally, irregular reddish-brown areas were observed ophthalmoscopically in each macular region. The infant died at the age of 31 days. Autopsy, limited to the nervous system, revealed a wide-spread encephalomyelitis, characterized by focal areas of inflammation and necrosis, and disseminated miliary granulomas. The right eye showed a localized chorioretinitis. A Protozoan morphologically identical with Toxoplasma was present in all the lesions.

Fresh tissue removed from lesions in the cerebral cortex and cervical spinal cord five hours postmortem was emulsified in sterile physiological saline. Four rabbits, 26 infant mice and 9 rats were inoculated with the emulsion intracerebrally. Eighteen infant mice were cannibalized by the mothers, but of the remaining 8, 6 showed the following evidence of having been infected: (1) They became ill and were sacrificed or died in from 18 to 40 days. (2) They showed lesions in the central nervous system resembling those seen in the human case. (3) Protozoa like those in the nervous system of the infant were present in the lesions. (4) Transmission to rabbits and mice was attempted from 4 of these mice and was successful in each instance, using brain tissue for intracerebral inoculation with the production of similar lesions containing parasites, and further successful serial passages. The other mice showed a meningo-encephalitis but no parasites.

Three of the rabbits died in from 9 to 13 days and showed a meningo-encephalitis. Parasites were found in the lesions in 2 and successful transmission of the infection to rabbits and adult mice by intracerebral inoculation of emulsified brain was carried out from each of the 3. The fourth rabbit and the 9 rats showed neither clinical nor pathological evidence of infection. Excluding 18 cannibalized infant mice and 6 rats dying shortly after inoculation apparently of cerebral trauma, one finds that 9 or three-fifths of the remaining 15 animals became infected. That this was not a spontaneous infection activated by the inoculations is evidenced by (1) the high percentage of infection following the inoculation of the human material, (2) the fact that toxoplasmosis has not been described in rabbits or mice in North America and (3) the absence of similar infection in many animals of the same stock similarly inoculated with other materials.

---

* Investigation aided by a grant from the Friedsam Foundation.

[1] A. Wolf and D. Cowen, *Bull. Neur. Inst. N. Y.*, 6: 306, 1937.

[2] A. Wolf and D. Cowen, *Ibid.*, 7: 266, 1938.

[3] J. O. W. Bland, *Lancet*, 219: 52, 1930. *Brit. Jour. Exper. Path.*, 12: 311, 1931.

[4] J. E. Fechet, *Flight Surgeon Topics*, School of Aviation Medicine, Randolph Field, Texas, 1: No. 2, 44–48, 1937.

In the first 6 months, 24 serial passages in rabbits and 22 in irregularly alternating rabbits and mice have been carried out by intracerebral or combined intracerebral and intraperitoneal injection of infected brain emulsion. Filtrates of emulsions passed through Berkefeld "N" filters proved non-infective. Of 148 rabbits inoculated, 131, and of 105 mice, all but 2, succumbed, the majority in from 5 to 9 days. Of 98 infant mice inoculated intracerebrally, 52 or four-fifths of the non-cannibalized succumbed, the majority in from 2 to 3 weeks. In most of the animals, symptoms did not appear until the last day of life. These included sluggishness, pareses, tremors, convulsions and respiratory difficulties. A rise in temperature beginning on the second or third day was noted in the rabbits.

In every instance, there was a severe disseminated encephalomyelitis marked by focal inflammation and necrosis. The exudate included lymphocytes, plasma cells, mononuclear leucocytes and fewer neutrophiles and eosinophiles. Granulomas like those in the infant's brain were often observed. Focal inflammatory lesions were less frequently encountered in the lungs, striated muscles, heart, spleen and liver. Parasites identical with those in the human case were found in large numbers in the lesions. Attempts to cultivate the Protozoan on a variety of media free of living cells failed.

In addition to rabbits and mice, chicks from 1 to 11 days old and guinea pigs were inoculated intracerebrally. These species proved susceptible as evidenced by the development of typical histologic lesions containing parasites. A rhesus monkey injected intracerebrally and subcutaneously remained well and its temperature continued normal. The susceptibility of this species to this strain of Toxoplasma is being investigated further.

Six rabbits which did not succumb to an initial inoculation were re-inoculated intracerebrally from 1 to 3 times within 3 weeks to 3 months and all proved to be immune. Eight control rabbits and 3 mice injected with the same material by the same route succumbed. Four mice which did not succumb to an initial inoculation were also re-inoculated intracerebrally and intraperitoneally within 2½ to 4½ months. All survived, while 2 rabbits and 11 mice used as controls succumbed.

That the microorganism isolated from the human case is a Toxoplasma is indicated by the following: (1) Its morphology corresponds to that of Toxoplasma of animal origin. (2) The course of the disease and the lesions produced in the animals inoculated with it are very similar to those noted in the same species by inoculation of a Toxoplasma of animal origin. (3) The susceptibility of the rabbit, mouse, guinea pig and chick to this Toxoplasma corresponds to the wide host-range of Toxoplasma of animal origin. (4) Convincing evidence of the nature of the microorganism was obtained by cross-immunity experiments. Toxoplasma from a guinea pig passaged through mice was kindly furnished us by Sabin and Olitsky.[4] The 6 rabbits and 4 mice, noted above to be immune to the human strain of Toxoplasma, were re-inoculated respectively intracerebrally, and intracerebrally and intraperitoneally with the Sabin-Olitsky strain using infected mouse or rabbit brain emulsion. All 10 animals proved to be immune. Seven control rabbits and 6 control mice succumbed. Conversely, 2 rabbits immunized against the Sabin-Olitsky strain proved to be immune to the human strain, while two controls succumbed. Working with the same strains of Toxoplasma, Sabin and Olitsky, using other methods, have confirmed this cross-immunity and will report their results in the near future. The Protozoan found in the infant might be called *Toxoplasma hominis,* with the reservation that it may later prove to be identical with one or all of the animal strains.

Four other cases[1, 2, 5, 6] (respectively from New York City, Chicago, Prague and Rio de Janeiro), very similar clinically and pathologically to the present case, have been shown by two of us to constitute a distinct disease entity marked by encephalomyelitis. In one of these reports,[6] the author mentioned focal inflammatory lesions in the heart, striated muscles and subcutaneous tissue as well. The lesions in each infant contained a parasite morphologically indistinguishable from that in the present case. There is little doubt then that they too were cases of toxoplasmic encephalomyelitis, although experimental evidence is lacking. That there may be other forms of human toxoplasmosis is very probable.

In conclusion, toxoplasmosis has been demonstrated in man. It has been shown to occur as a characteristic disease of young infants involving the central nervous system. The first experimental transmission of a human toxoplasmosis to animals is described.

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THE LOCALIZATION OF MINERALS IN ANIMAL TISSUES BY THE ELECTRON MICROSCOPE[1]

IN recent years there have appeared a number of articles on the electron microscope with reference to its use in biological investigations. Most of these papers have been confined to the possibilities of securing tremendously high magnification. In these studies the absorption of parts of an electron beam by the substance traversed gave rise to profile pictures, as it were, of bacteria, colloidal suspensions and in several instances epidermal cells. Another use of this new tool was in the examination of surfaces, particularly of metals, by means of the pictures resulting from thermionic excitation of electrons at the metallic surface. It occurred to us, about four years ago, that this latter adaptation of the electron microscope would be particularly useful in localizing minerals in sections of animal tissues.

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[4] A. B. Sabin and P. K. Olitsky, SCIENCE, 85: 336, 1937.

[5] J. Jankû, *Casopis lekarew ceskyck*, 62: 1021, 1923.

[6] C. M. Torres, *C. R. Soc. de Biol.*, 97: 1778, 1927.

[1] Aided by grants from the Rockefeller Foundation and the Josiah Macy, Jr., Foundation.

It has been appreciated for some time that gentle and careful ashing of sections of biological tissues gives a remarkably faithful picture of the topographic distribution of minerals in such materials Cells and their parts can be recognized with little difficulty. If material is prepared by a modification of the Altmann-Gersh[2] frozen dehydration method there is little chance that there is any perceptible shift in the cellular location of the inorganic constituents. Since most of the inorganic elements in tissues, particularly Na, K, Ca and Mg, are excited to thermionic emission of electrons at more or less specific temperatures, we expected to be able to differentiate between these various elements and localize them in cells. With this information at hand it seemed advisable to ash sections *in vacuo* on the surface of a barium and strontium coated cathode in the electron microscope.

After many experiments, both with apparatus and method, we have been able to secure pictures in which cellular structure in striated muscle, gastric mucous membrane, nerve and in other tissues can be clearly made out. So far the emission pictures which have been obtained have been due to magnesium and calcium only. It has been possible to localize these elements definitely in the contraction bands of frozen and dehydrated muscle. Epithelial cells of the mucous membrane of the stomach and intestinal tract show extensive concentration of magnesium and calcium in the free borders of the cells.

These results are being published in detail elsewhere, and the experiments are being continued.

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EXPERIMENTAL PROLIFERATIVE ARTHRITIS IN MICE PRODUCED BY FILTRABLE, PLEUROPNEUMONIA-LIKE MICROORGANISMS

A PROGRESSIVE, proliferative polyarthritis bearing a clinical and pathological resemblance to human rheumatoid arthritis was produced experimentally in mice with a filtrable, pleuropneumonia-like microorganism which was recently isolated from the brain of a normal mouse.[1] Arthritis can be produced in practically 100 per cent. of mice when 0.5 cc of a 24-hour culture is injected intravenously or 1 cc intraperitoneally. Swelling of the joints may appear as early as 4 to 5 days. The arthritis is migratory, new joints becoming involved while others recede. Fusiform swellings of isolated digits, seen so often in human rheumatoid arthritis, occur frequently in these mice. The process is progressive and chronic in one or more joints, leading often to ankylosis, especially in the knees. By the method of "blind passage"[1] the microorganism has been cultivated from chronically affected joints as late as 70 days after intravenous inoculation. Tests revealed that the microorganism does not multiply in the brain, viscera, pleura or peritoneum. Excepting the arthritis, the mice appear in good health and not one of 150 with joint involvement has as yet died of the infection. Pathological changes are limited to the joints, and, as in the human disease, consist chiefly of proliferation in the synovial membrane, the capsule, the perichondrium of the articular cartilage, combined with a synchronous proliferation of the connective tissue and probably endosteum of the epiphyseal marrow directly below the joint cartilage. Intracutaneous, subcutaneous, intramuscular or intrathoracic injection or nasal instillation with or without ether anesthesia induced neither arthritis nor any local or systemic disease. Rabbits and guinea-pigs developed neither arthritis, fever or other signs of disease after inoculation with large amounts of culture.

A pleuropneumonia-like microorganism recently isolated from toxoplasma-infected mouse tissues[1] differs from the strain just described, in that it can also multiply in the brain as well as in the serous surfaces of the peritoneum, pleura and pericardium with the production of a characteristic exotoxin which has a special affinity for the cerebellum and can give rise to chronic choreiform signs when it does not prove fatal. When the rapid toxic death which follows intravenous injection of the culture was prevented either by the use of older mice (at least 2 months of age) or by injection of the centrifuged microorganisms, about 30 per cent. developed an arthritis similar to that produced by the other strain. The two strains are not serologically identical but possess a common antigen. Both strains have been found to pass through 500 mμ but not 396 mμ gradocol membranes (kindly supplied by Dr. J. H. Bauer), while on one occasion it was possible, by preliminary filtration through a 584 mμ membrane, to obtain a positive filtrate through a 322 mμ membrane; this suggests that the size of the smallest unit capable of multiplication is in the same range of magnitude as that of vaccine virus.

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[2] I. Gersh, *Anat. Rec.*, 53: 309, 1932.

[1] A. B. Sabin, SCIENCE, 88: 575, 1938.

The necessity of applying similar methods of cultivation and study to human arthritis of unknown etiology is obvious. Whether or not a similar microorganism shall be found to play a part in related human affections, the experimental disease provides a useful tool in the investigation of many pertinent questions.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

DEVICES FOR VISUAL COMPARISON OF SPECTROGRAMS

IN the commonly used method of photographic spectrophotometry due to Howe, the absorption spectra of equal thicknesses of two substances which are to be compared, usually a solution and a sample of the solvent, are photographed side by side in as nearly perfect contact as possible. An essential part of the method is to determine the point or points at which the spectrograms are equally dark. The points usually are determined by visual inspection. They may be located by means of a microdensitometer, with a worthwhile increase in accuracy under certain conditions; but visual determinations are much more rapid and usually are sufficiently accurate.

It is well known that if the two spectrograms are not in perfect or nearly perfect contact, without visible gap or overlap, the accuracy attainable in visually determining the match points is greatly reduced. For this reason, great care is taken to obtain the best possible contact. This necessitates very careful and accurate adjustment of the relative positions of the light source and other parts of the apparatus. Indeed, while satisfactory contacts are usually attainable, perfect contact throughout the entire length of the spectrograms is impossible in practice, since the image spreads on the photographic plate to an extent which varies with the density.

Obviously the time and effort involved in obtaining accurate absorption data could be reduced greatly by eliminating the necessity for excellent contact of the spectrograms. A simple device has been found to do this very satisfactorily, making it possible to view the spectrograms in apparently perfect contact, even when there is a wide gap or overlap between them.

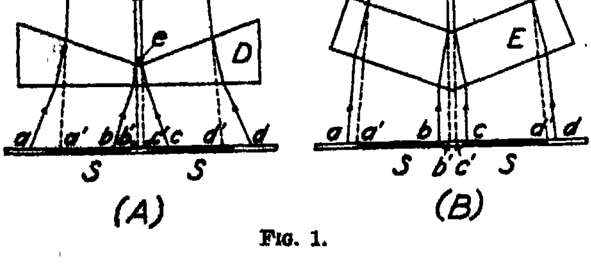

FIG. 1.

The device consists essentially of a biprism (Fig. 1-A) which is thinnest along the center line e. It is made preferably of a single piece of glass, but may be made of two prisms carefully ground and joined at the thin edges. It is held with its center line parallel to the lengths of the spectrograms and directly over the gap or overlap. Areas ab, cd, extending perpendicular to the plane of the paper, then appear at $a'b'$, $c'd'$ in the visual field, with b' and c' apparently in coincidence. Thus the edges of the areas, at b and c, appear in perfect contact, with no visible dividing line. The area between b and c is invisible. The distance from b to c varies with the refracting angle and with the distance from biprism to spectrograms. By varying this distance, comparisons of the two spectrograms can be made at various distances from the edges.

The division between the visual areas remains sharp, while the distance between biprism and spectrograms is varied from zero to at least several millimeters. This range can be increased greatly by viewing the spectrograms through a small circular aperture (one eye) or (using both eyes) a narrow slit extending parallel to the center line of the biprism.

For convenience and accuracy in use, the biprism should be mounted in an apparatus in which it can be adjusted to any desired position above the photographic plate, with its center line parallel to the edges of the spectrograms. A low-power lens and a viewing aperture may be mounted above the biprism. Illumination of the plate should be uniform and by transmitted light.

The device can be used also for comparing the intensities, positions, widths or line shapes of the lines in two spectra; in comparing two parts of the same spectral line, as a check on uniformity of width and of illumination of the slit; in comparing the darkening at two different wave-lengths in the same spectrum; etc.

Instead of the biprism, the refracting unit shown in Fig. 1-B may be used. This may be made of two plane-parallel plates of glass cemented together at an angle, or, preferably, of a single piece of glass. Areas ab, cd of the spectrograms appear at $a'b'$, $c'd'$, in perfect contact, as when using the biprism. This unit is less useful than the biprism, however, as the distance between b and c can not be varied by varying the distance between the device and the spectrograms.

A biprism which is thickest along the center line also may be used. This reverses the images of the two areas with respect to the center line. Two images of the gap or overlap are seen, on opposite sides of the contiguous areas. These images may interfere with accurate comparison of the two areas. For this reason the biprism first described is preferable.

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A GASOLINE-TORCH LABORATORY BURNER

THE Biological Survey, U. S. Department of Agriculture, maintains several research stations at points remote from such utilities as gas and electricity. Field workers at such stations are handicapped in not being able to use Bunsen burners or electrical stoves. This difficulty has been overcome at the Delta Migratory Waterfowl Refuge, in Louisiana, by utilizing a gasoline-torch stove. The stove was designed and constructed by Timothy Sullivan, a machinist at the refuge WPA project. It can be built at little cost, requires for heat only an ordinary gasoline "blow-torch" such as that used by plumbers, and produces a high heat with comparatively little fuel consumption.

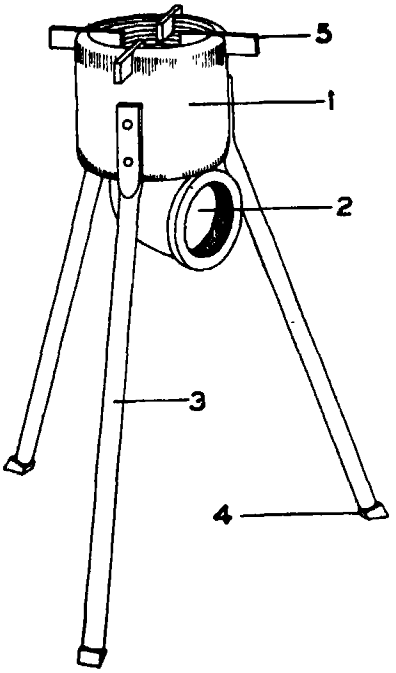

FIG. 1.

The Sullivan burner utilizes the following materials:

Materials: Many of these items may be salvaged from old machinery or from scrap-metal heaps. (1) One galvanized iron 3¼-inch pipe sleeve, 3¼ inches high. (2) One 1¾-inch pipe elbow. (3) Three pieces of ⅜-inch iron pipe, each 13 inches long. (4) Three pieces of rubber for insulating shoes for the legs of the stand. (May be cut from old automobile tire shoe.) (5) Four 2-inch lengths of ⅜ × ½ inch iron bar for grate. (6) Collar cut from ⅛-inch thick steel plate, to fit the inside diameter of the 3¼-inch pipe sleeve and with a hole to receive the 1¾-inch pipe elbow. (Not shown in figure.)

Assembly: One end of the elbow is welded to the steel collar, and this unit welded to one end of the pipe sleeve. This forms the body of the burner, the open end of the elbow being the flame intake, and the upper end of the sleeve the top of the burner. Then the top end of the sleeve is cut in four equidistant places to receive the lengths of iron bar. These lengths are spot-welded in place and form a grate. The ⅜-inch iron pipe is used for the stand, the upper end of each length being flattened and riveted to the outside of the lower half of the sleeve. The rubber shoes for the feet of the tripod stand may be cut with a projection that will fit up inside of the bore of the iron piping.

Use: a gasoline torch is heated and fired, and placed so that the end of the barrel is about an inch from the flame intake of the burner. The amount of heat may be regulated by adjusting the flame of the torch.

JOHN J. LYNCH

U. S. DEPARTMENT OF AGRICULTURE

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ENGINEERING'S PART IN THE DEVELOPMENT OF CIVILIZATION[1]

By Dr. DUGALD C. JACKSON

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SINCE the effects of engineering run all through living conditions, our topic is one of great importance to engineers and to engineering education. It is therefore appropriate for to-day's conference to be held here under the patronage of an important college of engineering and an organized society of engineers. The sub-topic ("The Social Significance of Engineering") which was under discussion this afternoon is a broad and pervasive one which means the import of engineering to society. The sub-topic also includes various others by implication. For example, it includes the social influence of engineering, which means the effect through the senses which engineering exerts on society; it includes the social implications of engineering, which means the intimate connections which relate engineering to social organization and social interrelations; and it also includes, among other things, the status or position of engineering as an entity with respect to society-organization as an entity. This evening I will go even more broadly into social relations and deal with the tripartite interrelations of engineering, social organization and civilization.

It is proper to here comment that true civilization grows as a consequence of community contacts among human beings, and intimate community contacts are (broadly speaking) made possible by and are dependent on the fruits of engineering. Such fruits became vaguely manifest many thousands of years ago and have steadily ripened and increased in scope and variety, through those thousands of years, down to the present time. Further ripening and variety-increases apparently will go on through future ages. I can not here go into the demonstration of the fundamental and continuous relations existing between social organization and engineering. I will refer those who may be interested to trace the growth of these influences to my six North Carolina lectures on "Engineering's Part in the Development of Civilization," which the American Society of Mechanical Engineers has thought worthy of publication, lecture by lecture, as a serial in its monthly magazine called *Mechanical Engineering.* This publishing began with the July issue and ends with the December issue of this year. In those lectures I have shown that community life was made possible by engineering; that some degree of civilization (which rests on principles of ethics and codes of morals) is a necessary accompaniment of community life; and, as a consequence, engineering is an inseparable companion of civilization. The increased responsibility for mutual sympathy and mutual welfare laid on individuals and on communities by the doctrines of the Christian religion have increased for engineering its opportunities to serve and its responsibilities.

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[1] Evening address delivered as part of Symposium on "The Engineer's Place in Modern Civilization," held at Lehigh University on October 26, 1938, under the joint direction of the University and the Engineers' Club of the Lehigh Valley.

The mental picture of the outcome of engineering usually held by human beings in the civilized world is of steam engines and what they have done for us; steam railroads; steam ships; electric telegraphs ("What hath God wrought!"); telephones; automobiles and hard-surfaced roads; radio sets and broadcasting stations; great structures like tall buildings, bridges, canals, harbors and irrigation works; potable water supplies and sewerage; manufacturing plants; manufactured products; and similar physical evidences. But these are only emblems, which are at the surface to-day. These are instrumentalities of engineering which have social significance, but it is inadequate, even superficial, to rest our attention with them.

To understand truly the social significance of engineering and the part that engineering has played in the development of civilization we must go deeper into the problems of society and the moulding influences of engineering thereon. It is necessary to begin with the conditions of the earliest village life, which originated in prehistoric times but which have left their records in the development of community life and civilization. We can picture these conditions from artifacts and other remains that have come down to us. It was through village life that civilization began, and through engineering that village life became possible. The single family or small group, living in a more or less roaming and precarious stage, had no civilization; but village life led to community of interests from which sprang the development of ethical principles and codes of morals that are the basis of civilization. It was thus that civilization germinated out of social organization.

Having germinated, it expanded over the world along with the movements of peoples, as sailing and rowing ships and maritime commerce grew up, and as extending trails and roads made some land commerce possible. Man seems to have been a natural trader in commerce after his gregarious period had arrived. The foundation development of civilization required a growing state of material and social well-being among men, with which there became associated a sympathetic mutual interest between individuals, and by individuals for the community welfare, in villages. It is the community of interests, which arises from integration of groups of people, that develops the qualities which characterize civilization; and conditions for living which make decent village life possible depend on engineering. Conscience and morals arise out of the social contacts in the family, clan and community, and civilization germinated in the community. Thus engineering was a frontier influence on civilization and social relations and it has been expanding that influence ever since.

The influences of metallurgy, of other engineering inventions, of agriculture, of domestication of animals, of written language became of great force among the early peoples; and community concentration became greater. Aided by engineering factors, trade between communities grew up and caused further extension of human contacts which depend for their amity on ethics and morals. Tools and simple weapons are evidences of artisanship, as also are crude pottery, weaving, simple agriculture and some domestication of animals. But the trail of rudimentary-structures, foresighted judgment regarding desirable village-locations and planned metallurgy, which trail was already trodden by some communities at the dawn of history, is the pathway of engineering—that is, it is the trail of the use of intellectual processes to bring together and combine the physical elements known to artisanship or science into a coordinated unity (such as a structure or process) for the convenience of man.

Add complex machines to these other engineering features, as is ultimately done in engineering, and we step far along in the possibilities for social relations. At the dawn of history man had come to the stage when security of life and livelihood could be sought after with some expectation of success for the most powerful few. Each step forward in the progress of engineering invention which contributed to the security of life and property for early men gave further impetus to the tendency toward community living, and this led to further emphasis also on ethical relations between man and man and tribe and tribe, and to furthering security of life and livelihood for man. In this connection the importance of the ethical relations is to be remembered. Power to control men's life and property without restraint gives power to control their subsistence, and this is equivalent to power over their will. Out of this condition most of the autocrats and dictators of the world have made their hold secure. Let us beware.

Civilization connotes harmonious cooperation of many human beings and also mutually sympathetic, helpful and elevated relationships. For early men, this civilization (such as there was) went hand-in-hand with the crudely growing engineering arts. This was because the engineering arts enabled groups of people to become closely associated for the purpose of securing their safety of life and ease of living without sacrificing either existing conveniences or major comforts, as far as conveniences and comforts were then available. The group association of people proved the need of rules and customs of the nature of ethics and morals and a practical application of those rules to life. Generation after generation, with hesitations, recessions and recoveries, somewhere in the world further steps in engineering improvements have been accomplished, with accompanying greater human intimacy and morality. The relations disclosed in our day show that there is still far to go before the goal is reached. Acceleration of the progress is desirable, but all records of experience show that incautious haste in reform measures is a fruitful cause of confusion and that it actually tends to delay the pace of progress in its major ways. It would be well for some of our "brain trusters" and "new dealers" to take these precedents in mind and restrain their impatience lest they bring us to disaster through egoistic lack of deliberation.

Each step forward in the progress of invention looking toward security of life and property for early man gave further impetus to the tendency toward community living, and this further forced a growing respect for simple mutual interests. However, it was only after the stimulus for making inventions had resulted in an easier life with regard to life-security, food and shelter, and also had released to individuals more time for cultivating physical ease, that growing ethical relations between man and man and tribe and tribe became strongly evident, and community living became smoother. The early aims of each human being seem to have included security (*i.e.*, safety for life and limb, sufficiency of food, adequacy of shelter from the elements) for self and family, such as characterize the objectives of most mammalian animals. Then man gradually came to desire the permanent establishment of health, recreation and contentment (or perhaps the correct word would be happiness) as part of his "place in the sun."

At the present period of our nation, our people are overdoing the shout for government supported "security" maintained for individuals without aid of their own contributions accompanied by sweat of the face. Nevertheless, reasonable security of life, livelihood, health and happiness is the stuff out of which civilization is made. Man has sought and still insistently seeks security of life with its concomitants, and also the greatest degree of convenience and comfort which may be derived from any given expenditure of energy.

When reflecting on this, we must remember that, as Sancho Panza says, "Good fare alleviates care." Engineering plays a strong part in meeting fundamental human aspirations. It is a human and intellectual affair. It deals with forces and materials provided by nature, and adapts them to human service for the satisfaction of human needs and aspirations as they are felt in each particular period, and in our period all commerce depends deeply on engineering. Gathering of raw materials, manufacturing, transportation, storage and even the handling of goods have become the children of engineering. Even farming (at least in America) has become permeated with the effects of engineering.

Moreover, as engineering achievements extend, the process of satisfying aspirations and needs stimulates human society (as individuals and as groups) to formulate additional aspirations, picture additional needs and claim their fulfilment. One's needs seem to increase along with one's opportunities, and failure to immediately satisfy the seeming needs, to the full, causes disappointment that seems like suffering. To safely qualify under such conditions, engineering must live under the guiding influence of the social philosophy of the successive periods, while always controlled by the restraints which characterize exact science.

This combination is a lively cause of friction. The stimulus of their aspirations and felt needs leads most human beings to press for an immediate fulfilment. This ambition often is encouraged and supported by theorists who have failed to observe that too great rapidity of change in social organization leads to ultimate harm instead of permanent satisfactions. Life in the aggregate is a composite of multifold relations and always has been. Revolutionary changes of social organizations usually leave a train of wreckage and hardship for all, including those most in need of improved conditions. Sound judgment demands that changes be made considerately, gradually and with careful forethought. Thoughtful consideration is the way of wisdom. The records of history make these relations plain, but time does not permit the exposition of those records here. During the past 150 years our engineering improvements which are competent to afford convenience and comfort for all people have come rapidly forward, but our legislative acumen and foresight have not advanced in equal degree in the same 150 years. Alexander Hamilton wrote in the *Federalist* 150 years ago that, "Necessity, especially in politics, often occasions false hopes, false reasoning, and a system of measures correspondingly erroneous." Hamilton's pregnant cautionary words still carry a significance equal to the significance which they held in his life-time.

As citizens, we of this nation are proud of the education from which we profit. There is considerable justification for the pride, but instances arise which show that the results of education have not fully permeated among the citizenship even for the most elemental affairs of life. I will cite an extraordinary illustration which was disclosed to me as a bona-fide occurrence. A married woman from low-income circles appeared almost annually at a hospital for delivery of a child until the family was an even dozen. Again she came, and (as she was leaving this time) the attending physician said, "I presume we will see you again next year." "No, ye'll not," said she, "me husband and me has just learned what makes them." This is quite on a level with the ignorance among some of the primitive aboriginal tribes of Australia and elsewhere, of which the natives "do not recognize sexual intercourse as a cause of conception" and give other specific causes.

If we still have in our midst such ignorance of fundamental biological phenomena which arise out of our personal intimacies, is it reasonable to expect a general sound knowledge of the less concrete phenomena of economics and society? Even our most expert citizens confess shortness in assurance regarding the latter phenomena. Therefore, the acute frictions (such as arise, for example, in the industries as a consequence of the close intimacies brought about so rapidly by the engineering inventions of the last two centuries) are likely to be the unhappy outcome of ignorance and prejudice. Such being the case, they are causes calling for sympathetic, man-to-man adjustment with such mutual forbearance as can be marshalled. The old-time destructive violence guided by violent minds, which was associated with industrial combats of my youth, is now outmoded in the minds of many of our citizens and must be brought to condemnation by all. Progress that is being made is the result of recognizing from all sides the advantages of man-to-man negotiation. Education which tends to the diffusion of truth, and thereby eradicates ignorance and prejudice, may come to the rescue.

A much fuller recourse by industries to plain, factual, impartial expositions to the public of their internal organizations, their external relations and their difficulties, widely circulated by means of advertisements, in my opinion, would help. Some industries have successfully utilized this process, although considerable advertising apparently intended for the purpose is so general that it is publicly accepted only as propaganda and has little influence. In many instances local advertising is excellent, but generally-flung advertising from the same sources often is superficial and is received by the public only as propaganda. Some writers of advertisements seem to give more weight to "catchy" wording than to accuracy of content. Many important industries limit their statements of factual character to periodical formal reports to owners (stockholders) and bankers, and these reports receive little general, public attention even when they are reasonably complete. Employes, customers and owners of industry and their families make up a goodly proportion of our population, and we may add to the three named categories those other members of the population who are often denominated the "public at large" as also parties in intellectual interest regarding industrial and other corporations. These should be catered to.

The factual and disclosing information which might enlarge knowledge and allay prejudice in this field is not readily available from books, monographs and magazine articles. Fuller measures of factual disclosure are needed so that honest and adequate information may be before the public in general. When we have in use in this country some nine tons of steel per capita of all our population and this figure grows faster than the population (I use estimated figures published by the American Iron and Steel Institute) we all are interested in the processes related to this important background of many affairs in our daily life.[2] I infer no criticism of the advertising displayed by the steel industry. Few industries do so much or so well, but I wonder whether the steel industry might not serve the public (and also the stockholders) by doing more. Constantly applied, careful efforts at making facts known throughout the nation, in my opinion, is a shining means for forestalling the effects of ignorance and prejudice and for thereby ameliorating a sore spot in the social relations occurring as a consequence of engineering. An uninformed public usually is influenced by predetermined notions and prejudices; but the American public, when it feels itself rightfully informed and has had time to reflect on its knowledge, usually proves itself to be fairminded. We are likely to forget that success in impressing the intelligence of great masses of people requires that clear, factual expositions shall be repeated again and again; although demagogic or inaccurate eloquence, once or twice expressed in fluent nonsense trickling from the speaker's tongue, may emotionally carry the same people into great error.

The inseparable relation of engineering to civilized society and to effective social adjustment is seldom given enlightened attention, and much of the fault of some ardently preached social doctrines is due to popular misunderstanding of the true sources for enlarging material wealth. It is an unavoidable reality of nature that increases of permanent wealth are gained fundamentally only from what is grown on the surface of the earth, and taken from within the earth, from the waters of the earth or from the air surrounding the earth; and that the processes of securing the wealth require muscular and mechanical power directed by the minds of men. For the populations to cease to work would mean that they would cease to live. We must keep industrious with minds and muscles or we can not live in the comfort and plenty which is an ideal among western nations—evolved to different degrees in different nations but existing in all. It is important also to remember that joy in useful accomplishment, by the individuals composing a society, is essential to the realization of the best social adjustment. How to achieve the desired end of inciting joy in accomplishment is indeed a problem; but the engineering of machinery to more and more lift long hours of muscular labor from the shoulders of men, associated with spreading mental effort more generally among men, is a promising path to the solution. Moreover, an increase of leisure which is so ardently desired by most people can only be accomplished by substituting in all practicable situations mechanical power for muscular power, by means of inventions which make the substitutions possible at moderate capital expense so that an extra margin of saving is produced, from which all concerned may profit. The phrase "all concerned" includes workers and customers as well as owners. It here is to be noted that scientific discoveries and engineering inventions which lessen the cost of useful processed products or which provide useful new products usually increase the rate of the production of new wealth.

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[2] Since the delivery of this address, competent critics have expressed the opinion that the figure of nine tons is too high; but in any event the total steel in actual use per capita is an important figure relating to our mode of life.

Engineering is a process of planning, organizing and executing work concerned with directing the forces of nature to the service of mankind; while the word civilization connotes well-established, sympathetic ethical and moral relationships in society. The latter relationships develop only where considerable numbers of people work together for common ends, and means of community living or other community contacts are provided by engineering for the grouping of the people in harmonious unity and providing for their material needs. This must not be mistaken for communism. It is quite the contrary. Full civilization connotes harmonious well-being based on mutual sympathy associated with ethical and moral relations in society, while democratic independence of the individual is maintained to the limit of conscience expressed without external restraint. Communism, on the contrary, suppresses individual independence; and it may destroy mutually sympathetic relations while providing for livelihood in common.

The human mind, in mass, is very slow to change in character; and stable improvements of mutual relations can not be rushed to success by the vaguely applied efforts of professional reformers or dilettantes in social affairs. Such improvements may only be successfully produced slowly, in association with sounder-growing mass-thought regarding living affairs in both material and ethical relationships; and here the influence of engineering in showing the ways to material betterment is of primary importance. Following in the wake of material betterment and increased leisure, intellectual improvement also usually comes as an ultimate contribution to social welfare.

By living in ready contact with each other, we have come to recognize (in at least a glimmering degree) that the best living is when life is put to intelligent use in mutual advantage. We yet have much to learn before this is realized at a reasonable level, but ultimately we will be able to mould our engineering so as to achieve the wished-for ends. Sound progress connotes aid in bringing forward those persons who need aid and are willing to cooperate in the effort at aid. It also connotes unrestrained encouragement of the practices of those who are competently proceeding with ethical consideration along their individually chosen creative courses. Unless American politicians can be brought again to follow such tenets, instead of following the hysterical urgings of professional reformers, we will be justified in persistent pessimism regarding human affairs in this nation.

One who studies with concentration the changes which have occurred in the living conditions of the populations of European nations during the last two hundred years, or of our people during the existence of our own nation, must be impressed by the great change for the great proportion of the people from sordidness and insecurity of life and livelihood to relative security, comfort and happiness. In these days, certain of our fellow citizens point to Sweden as a notable example of economic and social welfare. In a relative way, they are right; for Sweden has come forward in an admirable manner out of an age of sordid living and misery for most of its people. Means for ready and economical transportation, means for quick transmission of intelligence, means for generating and transmitting power, means for sanitation and other great engineering achievements have changed the face of the people. The sordid and miserable have been raised and the disparities in security and happiness which formerly existed between the few and the many have been notably lessened by improving the lot of those formerly miserable.

The same miracle has occurred to the people of the

British Isles, France and other nations. The changes have been gradual but effectual, and they continue their course. The sound results have come from utilizing cautiously applied measures for lifting the many. Where tearing down the superior economic and security status of the few has been practiced, it has always left in its train a legacy of disadvantages and misfortunes that affected people in all conditions of living.

Our experiences have not been without analogy to the experiences of European peoples and we may well examine the sign boards of their history. We started later, with a pioneering people whose active utilization of their restless intelligence in a favorable setting did much for them. Our utilization of engineering achievements has been correspondingly active, and engineering invention has gone on at a high pace. The living conditions for our healthy and industrious citizens have been at a high level compared with the corresponding citizens of Europe. If one third of our citizens are inadequately provided with food, clothing and shelter (as viewed from our accepted standard of living), as has been alleged, I presume with truth, they are among those who need betterment and should be shown practical means by which they can come to betterment. But the precedents show that no general gain is secured by pulling down some with the object of raising others, nor by over-fast efforts at general reforms such as have been pressed forward by our professional reformers and some of our politicians during the past several years. Our social changes, if they are to be truly serviceable, must proceed at the pace which characterizes natural improvement of thought in an environment of encouragement, and they must not be unethical, or our results in the end are likely to be adverse for those who should be helped instead of affording the betterment which is desired.

Politics in this country are seldom free from false slogans of which the unsoundness would be exposed by exacting analysis. We now are suffering from the effects of various partially or wholly false slogans that relate to the fields of government, engineering, education and security, which have been formulated to satisfy the supposed slogan-hunger of the majority of mankind. For illustration, the false doctrine that civilization is decaying has been asserted again and again during the period from several thousand years ago to the present time and people still volunteer their ideas for saving civilization. The answer is plainly spread before us. If decay had in fact been going on over this long period, there would be mighty little civilization left with us to-day—instead of which we have in the best parts of the western world a civilization which is superior, in the sense of being more comprehensively helpful to man, than that existing anywhere in any of the preceding centuries. This statement rings true when it is tested by comparison of to-day's conditions of the great mass of people with earlier conditions, whether two generations, two centuries or two thousand years back.

If moral relations and security of life mean anything in happiness, as most of us believe, there is more happiness in this country to-day than heretofore in any country of great population. There certainly are more comforts in life than in any earlier time, and more leisure for most people, mostly brought about by engineering applications of science. And even from this level, progress continues in a clear pace. Trying to over-accelerate that pace by poorly conceived political nostrums harms instead of helps. Efforts put forth to save civilization are only folly and are not needed. What are needed are efforts to deepen and enrich the spirit of sympathetic understanding between men, so as to better the conditions for negotiating the amelioration of those differences which may injuriously arise because of our more constant and intimate mutual contacts.

Engineering processes and engineering devices have been (and are being) abused by use in warfare, but not by choice of the leading minds of the engineering profession. The profession, with few exceptions, stands on the conviction that war is tragic, expensive, inefficient and unnecessary. However, as world affairs display themselves, we must be prepared in an organized way as a nation to stand against aggression from without in case aggression should arise in spite of friendly negotiations planned to prevent forcible action. Convince man that war will not ultimately result in greater wealth, security and stability for himself and his nation and the tendency toward organized war will be weakened. Especially will this be achieved if other sufficient routes are kept open on which men's love of risk and adventure can be fully expended, while the paths to selfish profit during war are closed. It lies with us to hold so steadfastly to the duty of more fully developing the peaceful occupations of agriculture, industry and commerce that the minds of our people may be turned away from contemplating aggressive expansion and warfare. Engineering favorably influences all those peaceful occupations, and we engineers have an obligation to ourselves and our fellow citizens to encourage the highest practicable development of these ethical aspects of engineering.

That is the attitude of engineering in this aspect of its social relations. The defects in human relations which arise in local, national and international affairs are due neither to faults in the fundamental ideal of a complete civilization, nor to engineering which has set up and continues to maintain the stage for a possible realization of that ideal. A grave responsibility rests on critics of our status, who are failing in the call for agitation and education of the public to a realization of the relative fitness of things. This is a personal and group matter to achieve, and it can not be achieved by partisanship or foul play.

Much has been accomplished in the long-time development of civilization. Much is yet to be accomplished. The accomplishment can not be secured in any nation by legislation alone. The solution can be obtained by joint use of two paths. One of these leads to continued emphasis on sympathetic negotiations between man and man, or group and group, before going to extremes. Much progress for our country has been made in this path during the past half century. Such progress has been notable in our engineering industries, but nevertheless it is yet insufficient, and more sympathetic relations must be fostered. However perfect a coin may appear on one face, if it is suffering from corrosion on the other face it is defective and needs reminting. Social reminting in an engineering world with its democratic qualities, however, requires a depth of consideration and range of cautious adjustments which immeasurably transcend the requirements for the machine-reminting of coins.

The other path leads to the joint problem of education in engineering and political economy which is now crying for solution in order that the social problems may be smoothed and society may be aided to make progress in the best sense. Our national needs are, on the one side, a moratorium on loosely drawn legislation, careful simplification of laws which we have, and primarily emphasized efforts to make ethical principles a guide in both the observation and the administration of statute-law. Abstract justice is an ideal, but enforcement of law according to ethical principles can be made a very practical thing.

On the other side, our national needs include a careful nurturing of the results of scientific research and discovery in the fields of natural science and of so-called social science, which may stimulate engineering invention and engineering practice out of which still further improved living conditions may arise. Many endowments for research in natural science and in economics and sociology exist, and our need is for an endowment to promote the study (including research and exposition) of the joint relations of engineering and political economy, having for its purpose to establish an understanding of the most helpful relations which may be built up for a prosperous social welfare. This is a need indeed, and a donor can make the nation his never-ending debtor by establishing an endowment to this end.

OBITUARY

EDWARD SAPIR

THE death of Edward Sapir on February 4, 1939, when in mid-career, marks a loss of leadership in anthropology and linguistics. It will be difficult to find another who possesses his distinctive assets of originality, profundity and insight.

Born in Lauenburg, Pomerania (January 26, 1884), he was brought to the United States as a little child. His formal training was at Columbia University: A.B., 1904; A.M., 1905; Ph.D. in 1909 under Franz Boas. His initial professional appointments were as research assistant, University of California (1907–08) and instructor in anthropology, University of Pennsylvania (1909–10). During this period, he was concerned with analysis of several western Indian languages (Yana, Wishram, Takelma, Southern Paiute).

As chief of the division of anthropology, Geological Survey of Canada (1910–25), his own research was primarily with the language and culture of several northern Indian groups: Nootka and Athapascan. These remained preoccupations through his life, the latter especially giving rise to an extended comparative study of the far-flung Athapascan stock and its Sinitic connections. It was at this time that he developed an interest in psychological and psychoanalytic insights into linguistic and cultural behavior.

In 1925 Dr. Sapir began a systematic teaching career: assistant professor of anthropology (1925–27), professor of anthropology and general linguistics (1927–31) at the University of Chicago; Sterling professor of anthropology and linguistics at Yale University (1931–39). His enthusiasms fired a group of highly competent linguistic students who will, without question, give continuity to his views in the next generation.

He received manifestly deserved academic recognition: honorary Sc.D. from Columbia, 1929; membership in National Academy of Sciences, American Academy of Arts and Sciences, American Philosophical Society, Société des Américanistes de Paris, Reale Accademia della Scienze (Bologna); and was elected president of the Linguistic Society of America (1933) and the American Anthropological Association (1938).

His ethnographic studies were, for the most part, incidental products of his linguistic work. But this gave them a distinctive quality, namely, a constant illumination from linguistic insights. This approach marks his principal contribution to ethnological method, "Time Perspective in Aboriginal American Culture" (1916). His published ethnographic reports are few and brief, but a deftness and incisiveness make them models of description. His two little papers on the Takelma of Oregon, for example, are marvels of succinct presentation and put to shame many a more pretentious monograph. It is therefore regrettable that he left incomplete his magnificent collection of materials on Nootka, Yana and Hupa.

Dr. Sapir's major published contribution, however, lies in the field of language. His control of the perfected techniques of Indo-European and Semitic philology was extended into the realm of primitive languages. Lexical and grammatical contributions, ranging from Hebrew and Tocharian to American Indian Uto-Aztecan, Hokan, Athapascan and Wakashan, attest his extraordinary fertility. The soundness of these analyses can not be challenged. Beyond this, though fully *recognizing independent developments*, his emphasis on "drift"—the idea that languages differentiated from a common base will show parallel modifications—led him to suggest genetic connection in families previously regarded as distinct.

The more unique contribution lay, not in structural nor historical phases, but in language as a psychologic-symbolic phenomenon. In the first place, he offered in "Language" (1921) a new approach of broad philosophic sweep. Pointing out that the traditional classification of languages relates properly only to their techniques, he emphasized the more fundamental characterizations of conceptual types and degrees of synthesis. The primary concern is with basic concepts, their radical or relational, pure or concrete nature, and the mechanisms for their expression. Essentially, this is emphasis on language as thought rather than as form.

His studies of the interrelations of psychiatry and culture are closely allied to this. Here he was concerned that psychiatry and psychoanalysis should profit from a study of variant cultural matrices and that cultural behavior as mechanism for thought and living should be understood in terms of psychological experience. When chairman of the Division of Anthropology and Psychology, National Research Council (1934–35), he had opportunity to lay the groundwork for coordinated studies along these lines, which may be expected to bear future fruit.

His most striking personal characteristics were a crystalline quality of thought and speech and an ever-present kindliness. The artistry of his effortless verbal performances, his articulateness, was a delight. It is no accident that half his writings are groups of poems, literary and musical criticism, showing the same heightened sensibility to nuances of sound and meaning, the same intuitions, that fertilized his linguistic and psychiatric work.

No life can be long enough to accomplish the program he set for himself, but we can only regret that his proved so brief.

LESLIE SPIER

NEW HAVEN, CONN.

EDMUND CECIL SHOREY

1865–1939

DR. EDMUND C. SHOREY, retired senior biochemist of the Bureau of Plant Industry, U. S. Department of Agriculture, died on January 30 at Emergency Hospital, Washington, D. C., after a protracted illness. He served, since retiring in 1935, as a collaborator with the Division of Soil Fertility Investigations, where formerly he was in charge of biochemical investigations of soils and fertilizers.

Dr. Shorey, born on March 5, 1865, in Lanark County, Ontario, Canada, was graduated from Queens University, Kingston, Ontario, with a B.A. degree in 1886, an M.A. degree in 1887, a D.Sc. degree in 1896 and gold and silver medals in chemistry and natural science, respectively.

His professional career began as chemist for the Kohala Sugar Company of Hawaii in 1893. Upon annexation of Hawaii in 1899, he became food commissioner for the territory and served for four years. In 1903, Dr. Shorey entered the field that later held his major attention, when he joined the Hawaii Agricultural Experiment Station as chemist. In 1907 he was transferred to the Bureau of Soils in Washington, D. C., and was associated with the Division of Fertility Investigations until 1915, when he was placed in charge of the Division of Chemical Investigations. He left the government service in 1918 to engage in industrial chemical research, but returned to the Division of Soil Fertility Investigations in 1922 as biochemist, becoming senior biochemist in 1928.

Dr. Shorey's major interest was in the organic constituents of soils and the nature of humus. His outstanding research in this field gained him an international reputation. His intense interest in this research was maintained until the last, as evidenced by the publication last March of his work upon the presence of allantoin in several soils. He was actively engaged in similar work up to his final illness.

Dr. Shorey was a fellow of the American Association for the Advancement of Science, a member of the American Chemical Society for more than forty years, a member of the Society of Biological Chemists, a member of the Washington Academy of Sciences and a fellow of the American Institute of Chemists. His home at the time of his death was in Falls Church, Va.

OSWALD SCHREINER

BUREAU OF PLANT INDUSTRY

RECENT DEATHS

WILLIAM H. COLLINS, director of the Observatory of Haverford College from 1892 to 1904 and prefect of the college from 1897 to 1919, died on March 11, aged seventy-nine years.

WILLARD DELL BIGELOW, since 1913 director of the research laboratory of the National Canners Association, died on March 6 at the age of seventy-two years.

He was a member of the Bureau of Chemistry of the U. S. Department of Agriculture from 1892 to 1913, the last ten years as assistant chief.

DR. FERDINAND VON LINDEMANN, professor of mathematics emeritus of the University of Munich, died on March 7 in his eighty-seventh year.

SCIENTIFIC EVENTS

WORK OF THE SCHOOL OF TROPICAL MEDICINE AT THE UNIVERSITY OF PUERTO RICO

THE School of Tropical Medicine of the University of Puerto Rico under the auspices of Columbia University, according to the annual report of Dr. George W. Bachman, director of the school, has completed twenty-five research projects out of fifty-eight undertaken. Current investigations include nutrition and malnutrition, parasitism, epidemiological surveys, skin and fungi studies, immunological response to infections, biological properties of various agents of disease, pathological and blood examinations and clinical work.

A survey of the health and socio-economic conditions found in the tobacco, coffee and fruit regions of Puerto Rico was carried on by the department of bacteriology in cooperation with the Puerto Rico Reconstruction Administration. The department also investigated streptococcus infection in the tropics. It has commenced a study on the incidence of pneumococcus with relation to the cultural and biological characteristics of the flora of the respiratory tract of normal Puerto Ricans.

A study of tuberculosis in tonsils was carried forward in collaboration with the Henry Phipps Institute of Philadelphia, and a study of the prevalence of abortion diseases in cattle of the Island was made in cooperation with the Bureau of Animal Industry of the U. S. Department of Agriculture. A joint investigation by the department of chemistry and the Agricultural Experiment Station was made of forage crops.

The department of medical zoology made a study of vitamin A and the part it plays in immunology to invasion by schistosomes or blood flukes. An extensive survey was conducted in several sections of the Island to find the breeding places of the sandfly.

An epidemic of black "piedra," a disease of the hair marked by small stony nodules never before reported in North America, was traced by the department of mycology and dermatology to a fungus classified as "Piedraia hortai." A parasite survey of mice, never before attempted in Puerto Rico, but facilitated during the year by quantities of rodents brought into the department of pathology, brought to light several parasites previously unrecorded in the Island, and one trematode, or fluke, hitherto considered only an Old World inhabitant. The chance finding in the laboratory of a wild brown mouse, sickly and deformed and presenting all the characteristics of the musculotaneous variety of leprosy, as seen in rats, opened a new problem of investigation on the character of spontaneous leprosy in mice. The department of pathology made a further study of the problem of internal hydrocephalus of rabbits.

Research on the medicinal properties of Puerto Rican plants is now being conducted at the University of Wisconsin by Conrado Asenjo, Jr., fellow of the Guggenheim Foundation and a member of the chemical staff of the school. Under the guidance of Professor Karl P. Link, of the University of Wisconsin, plans for a laboratory of phytochemistry are being elaborated for the continuation of this work at the school.

Reforestation of the Island of Santiago off the Eastern coast of Puerto Rico is under way in preparation for use of the island as a free range for apes. Gibbons collected for breeding purposes from the mountains near Chieng Mai, Siam, by Dr. C. R. Carpenter, of the Columbia University School of Medicine, will be transferred from the modern cages now housing them to the Island, and a field laboratory will be constructed.

Occupancy of the University Hospital in San Juan, which is being remodeled under the supervision of the Puerto Rico Reconstruction Administration, will be effected by March, 1939.

ADMISSION REQUIREMENTS IN THE COLLEGE OF ENGINEERING AT CORNELL UNIVERSITY

BEGINNING next September, a more comprehensive and closely controlled plan of selective admission will be adopted in all four schools of the College of Engineering at Cornell University, according to an announcement made by Dean S. C. Hollister. The School of Chemical Engineering has had such a system since its establishment last July, when it was decided that available facilities for instruction could accommodate only about a hundred of the more than three hundred applicants for admission to the freshman class. Increased enrolment in the Sibley School of Mechanical Engineering this year has produced another serious problem, and similar conditions are foreseen in the Schools of Civil and Electrical Engineering.

The number of applicants admitted to the several schools of the college is limited by the facilities available for adequate instruction. Since the number of applicants exceeds these limits, the Committee on Admissions in each of the schools will exercise discretionary power in selecting those to be admitted. Preference will be given to those candidates whose academic preparation and personal character would indicate fitness to pursue with success the course being undertaken and who show evidence of professional promise.

The need for additional facilities has been felt for some time, and a committee of the Board of Trustees, of which Bancroft Gherardi, retired vice-president and chief engineer of the American Telephone and Telegraph Company, is chairman and Provost H. Wallace Peters is secretary, has undertaken a program to strengthen the resources of the college. Among the first objectives are a new building for the School of Chemical Engineering and a Materials and Metallurgy Laboratory, which will allow expansion of classroom and laboratory instruction, especially mechanical engineering.

It is estimated that undergraduate enrolment in the College of Engineering, even under the improved selective admission plan, will reach 1,200 next year, a figure within 300 of the maximum to be provided for when the proposed building program is completed. A statement by Dean Hollister says: "Cornell's standards in engineering education have always been high and will not be lowered. Under present conditions, our policy must be to offer the facilities we have to those students best qualified to make advantageous use of them."

THE CHEMICAL ENGINEERING LABORATORY OF THE CASE SCHOOL OF APPLIED SCIENCE

THE Chemical Engineering Laboratory of the Case School of Applied Science, which has been completed at a cost of more than $300,000 and which is the first unit of a group to be devoted to the department of chemical engineering, will be dedicated on Saturday, April 15. At a luncheon which will precede an inspection of the building, Dr. William Reed Veazey, of the Dow Chemical Company, of Midland, Mich., formerly professor of chemical engineering at the school, will be the principal speaker.

The new building, which is now in course of being occupied, provides facilities for teaching and research in physical and organic chemistry, chemical engineering and plant design and offices and research laboratories for the staff. The main unit comprises three floors and a basement; an annex of two stories adjoins this. The main building is 104 feet long and 61 feet wide; the annex has a frontage of 44 feet and a depth of 60 feet. Constructed of steel and concrete with a shale brick exterior, the building is of modern industrial type with a maximum of natural light, which is provided through a continuous run of windows along the full length of each floor.

Laboratories in the new building include those for unit operations, senior development, organic chemistry, physical chemistry, fuels, water and lubricants and chemical engineering. The latter will be located in the two-story annex, which will provide space for larger apparatus for use in distillation, absorption and evaporation. Also included are seven offices with private laboratories, an auxiliary research laboratory and three recitation rooms. Service rooms include a mechanics shop, mechanical store room, grinding room and drying room in the basement; furnace room, students' shop and balance room on the first floor; instrument room on the third floor, while in a pent house is an automatic distilled water system and ventilating fans to insure change of air in all laboratories and offices at intervals of from four to six minutes.

The building will care for approximately 40 per cent. of the space needs of the department. Until additional units are constructed, work in general chemistry, quantitative and qualitative analysis and graduate work in many fields must be continued in the 44-year-old building. The old building will continue to house the chemistry library.

The new building has been designed by Walker and Weeks, Cleveland architects, who have worked in close conjunction with Dr. Carl F. Prutton, professor of chemical engineering, and members of the faculty in this department. Construction has been in the hands of the Sam W. Emerson Company, of Cleveland.

SURVEY OF MEDICAL RESEARCH FACILITIES IN CANADA

THE Associate Committee on Medical Research of the National Research Council met in Ottawa on February 27 and 28. The committee had before it the report on the survey of medical research facilities in Canada that was carried out at the instance of the committee by its chairman, Sir Frederick Banting.

Consideration was given to the fields of medical research in which work could now be organized and a conclusion was reached that immediate attention should be given to tuberculosis and rheumatic diseases. In each of these fields projects are to be initiated in a number of institutions throughout the country where the particular investigations can be carried out with economy and advantage. The projects in these fields will be correlated by the Medical Research Committee.

In the field of cancer research the committee decided to give first attention to the continuation of work on the standardization of x-ray dosage which has been undertaken in cooperation with the National Physical Laboratory in England and the National Bureau of Standards in Washington making use of the high voltage apparatus available in the National Research Council Laboratories in Ottawa. With the increase in voltage and power of the equipments becoming available for clinical treatment in Canadian hospitals, the information on standardization and dosage measurements to be obtained is regarded as basic.

Attention was directed to the importance of developing research in the various institutions throughout Canada so that in due course as the committee extends its work the required facilities and trained personnel may be available. To this end several assisted researches on a wide variety of subjects have been proposed, and the various medical institutions concerned are being invited to undertake this work under the auspices of the committee.

Sir Frederick Banting presided at the meeting and Major-General A. G. L. McNaughton, president of the National Research Council, and Dr. R. E. Wodehouse, deputy minister, Department of Pensions and National Health, were present as *ex-officio* members of the committee. The other members present included: Dr. Donald Mainland, professor of anatomy, Dalhousie University; Dr. J. E. Gendreau, director, Radium Institute, University of Montreal; Dr. J. B. Collip, professor of biochemistry, McGill University; Dr. A. Grant Fleming, dean of the faculty of medicine and professor of public health, McGill University; Dr. W. G. Penfield, professor of neurology and neuro-surgery, McGill University; Dr. G. H. Ettinger, professor in the department of physiology and embryology, Queen's University; Dr. T. H. Leggett, Ottawa; Dr. J. C. Paterson, director of the pathological department of the Civic Hospital, Ottawa; Dr. Duncan Graham, head of the department of medicine, University of Toronto; Professor V. E. Henderson, secretary-treasurer of the Banting Research Foundation, Toronto, and Dr. P. H. T. Thorlakson, assistant professor of surgery, University of Manitoba.

THE NATIONAL ASSOCIATION OF BIOLOGY TEACHERS

DR. GEORGE W. HUNTER, III, secretary of the Union of American Biological Societies, writes that at the annual meeting of the Union of American Biological Societies in Richmond on December 28 membership in the union was voted to the newly formed National Association of Biology Teachers—an organization of those who teach secondary school biology and others with allied interests. This association was formally established on July 1, 1938, in New York, largely as the result of the activity of the Committee on the Teaching of Biological Science, of which Dr. Oscar Riddle is chairman. The association already has a membership of approximately 2,000, and has founded a journal—*The American Biology Teacher*—issues of which have appeared monthly since last October. The committee is continuing its efforts to enroll teachers of secondary-school biology in this association and to increase the value and influence of its new journal. Professional biologists everywhere can now give valuable and much needed support to this enterprise. At the Richmond meeting the union formally adopted the recommendation "That professional biologists of the United States take notice of the very recent formation of a National Association of Biology Teachers, and that they assist this new organization by submitting suitable material to its journal and otherwise by encouraging or promoting the formation of local units of the association in their own communities."

Communications may be directed to the committee representative, Professor David F. Miller, the Ohio State University, Columbus, and other correspondence should be addressed to the Secretary-Treasurer of the National Association of Biology Teachers, P. K. Houdek, Robinson, Ill.

ELECTION OF RESIDENT MEMBERS OF THE WASHINGTON ACADEMY OF SCIENCES

RESIDENT members of the Washington Academy of Sciences have recently been elected as follows:

Harry S. Bernton, practicing physician and professor of hygiene and preventive medicine, Georgetown University, in recognition of contributions in the field of protein sensitization.

Gerard Dikmans, parasitologist, Bureau of Animal Industry, in recognition of his contributions to parasitology, especially helminth parasites of ruminants.

Irvine T. Haig, principal silviculturist, U. S. Forest Service, in recognition of his contributions to forest research, particularly on the growth, yield and natural reproduction of the western white pine of the Northwest.

Elmer Higgins, chief of the Division of Scientific Inquiry, U. S. Bureau of Fisheries, in recognition of his contributions to marine biology as related to the fisheries.

Hugh Curtis McPhee, chief of the Division of Animal Husbandry, Bureau of Animal Industry, in recognition of his contributions in the field of genetics of plants and animals.

Elmer Martin Nelson, principal chemist of the Food and Drug Administration, in recognition of his researches in the field of nutrition and vitamins.

Walter Ramberg, physicist of the National Bureau of Standards, in recognition of his contributions to mechanics, in particular his researches in the mechanics of structures.

Sanford Morris Rosenthal, senior pharmacologist of the National Institute of Health, in recognition of his researches on the test for liver function, the pharmacology of arsphenamines and mercury and the chemotherapy of sulfanilamide.

Harry Waltner Titus, senior biological chemist of the Bureau of Animal Industry, in recognition of his contributions to the physiology and chemistry of nutrition, in particular the nutrition of poultry.

Everett Elmer Wehr, associate zoologist of the Bureau of Animal Industry, in recognition of his contributions to helminthology, particularly nematode parasites of birds.

DR. ALBERT EINSTEIN

THE sixtieth birthday of Dr. Albert Einstein occurred on March 14.

He said:

> My birthday affords me the welcome opportunity to express my feelings of deep gratitude for the ideal working and living conditions which have been placed at my disposal in the United States. I am also very happy over the prospects of becoming an American citizen in another year. My desire to be a citizen of a free republic has always been strong and prompted me in my younger days to emigrate from Germany to Switzerland.
>
> What distinguishes a true republic is not only the form of its government but also the deeply rooted feelings of equal justice for all and of respect for the person of every individual.

SCIENTIFIC NOTES AND NEWS

THE National School of Biological Sciences of Mexico recently opened with appropriate ceremonies a new laboratory of entomology, which is named in honor of Dr. Leland O. Howard, chief of the U. S. Bureau of Entomology from 1894 to 1927 and principal entomologist of the U. S. Department of Agriculture from 1927 to 1931, when he retired. Ambassador Josephus Daniels made an address in which he outlined Dr. Howard's career.

DR. HENRY NORRIS RUSSELL, research professor of astronomy and director of the observatory of Princeton University, and Professor A. Pictet, of Geneva, have been elected associates of the section of mathematical and physical sciences of the Royal Academy of Belgium.

PROFESSOR HARLOW SHAPLEY, director of the Harvard Observatory, has received the Bruce medal of the Astronomical Society of the Pacific in recognition of his "distinguished services to astronomy."

M. BERNARD LYOT, of the Meudon Observatory, to whom the Gold Medal for 1939 of the Royal Astronomical Society has been awarded, will deliver the George Darwin Lecture before the society on May 12.

THE James Alfred Ewing Medal of the Institution of Civil Engineers has been awarded to Professor A. H. Gibson, professor of engineering in the University of Manchester.

THE James Scott Prize of the Royal Society of Edinburgh was presented to Professor P. A. M. Dirac, Lucasian professor of mathematics at the University of Cambridge, at a meeting of the society on February 6, when he delivered an address entitled "The Relation between Mathematics and Physics."

THE Cameron Prize of the University of Edinburgh for 1939, the value of which is about £200, has been awarded to Dr. Gerhard Domagk, of the Institute for Experimental Pathology and Bacteriology, I. G. Farbenindustrie, Elberfeld, Germany, "in recognition of his discoveries which initiated the treatment of diseases of bacterial origin by compounds belonging to the sulphonamide group."

DR. ALEXANDER SILVERMAN, head of the department of chemistry in the University of Pittsburgh, has been elected a member of the French Association of Scientific and Technical Ceramics.

THE University of Cincinnati Chapter of Sigma Xi has elected the following officers: *President*, Dr. Glenn E. Cullen, professor of biochemistry and director of laboratories of the Children's Hospital Research Foundation; *Vice-president*, Dr. Frederick O'Flaherty, director of the Leather Research Laboratory of the University of Cincinnati; *Secretary-treasurer*, Dr. Saul B. Arenson, professor of inorganic chemistry, University of Cincinnati.

DR. HAROLD PERCIVAL HIMSWORTH, deputy director of the Medical Unit at University College Hospital, has been appointed to the university chair of medicine, tenable at University College Hospital Medical School, University of London.

DR. C. D. DARLINGTON has been appointed to succeed Sir Daniel Hall as director of the John Innes Horticultural Institution, Merton.

DR. F. L. GOLLA, professor of the pathology of mental disorders at the University of London, has been appointed director of the new Burden Neurological Institute in the grounds of Stoke Park, near Bristol. The building comprises laboratories for biochemical, physiological and endocrinological research, together with two observation wards each containing ten beds. The institution will be opened by Sir Thomas Inskip early in May.

H. W. GRAHAM, general metallurgist of the Jones and Laughlin Steel Corporation, Pittsburgh, has been elected chairman of the executive committee of the Industrial Research Institute to succeed Robert B. Colgate, of New York. H. Earl Hoover, vice-president of The Hoover Company, Chicago, Ill., was elected vice-chairman. New members of the committee are: L. W. Wallace, of Chicago, Ill., director of engineering and research for the Crane Company, and F. W. Blair, of Ivorydale, Ohio, chemical director of the Procter and Gamble Company.

DR. GEORGE C. SHATTUCK, clinical professor of tropical medicine at the Harvard Medical School, has been reelected president of the Massachusetts Health Council.

DR. GEORGE D. OBERLE, formerly an agent for the U. S. Department of Agriculture, has been appointed associate in research in pomology at the New York State Agricultural Experiment Station at Geneva.

THE Committee on Scientific Research of the American Medical Association has made a grant to Dr. George Herrmann, of the Medical School of the University of Texas, for continuation of his study of the physical and chemical changes in heart muscle under varying experimental conditions, and to Dr. Charles Weiss, director of the Research Laboratories of the Mount Zion Hospital, San Francisco, to permit him to continue his researches on the immunology of staphylococcus infections.

DR. PHILIP C. JEANS, professor of pediatrics at the College of Medicine of the State University of Iowa, has received a grant of $7,500 from the Borden Company for the continuation of his investigations in infant nutrition. This grant was made available through the Council for Pediatric Research of the American Academy of Pediatrics.

PROFESSOR C. L. SHEAR, who retired in 1935 as principal pathologist in charge of mycology and disease survey of the Bureau of Animal Industry at Washington, is spending three months at the Citrus Experiment Station of the University of California working on the classification of fungi.

DR. ERNEST E. IRONS, formerly dean of the Rush Medical College of Chicago, and Dr. Peter Bassoe, professor of neurology, lectured recently at the School of Tropical Medicine at San Juan, Puerto Rico.

THE John Howard Appleton lecture at Brown University will be given on March 25 at 8:15 P.M. by Dr. J. E. Lennard-Jones, professor of theoretical chemistry at the University of Cambridge and fellow of Corpus Christi College. He will speak on "The Structure of Liquids."

DR. STEPHEN W. RANSON, director of the Neurological Research Institute of the Medical School of Northwestern University, gave the Charles R. Bardeen Memorial Lecture at the University of Wisconsin on February 8.

DR. CARL D. ANDERSON, associate professor of physics at the California Institute of Technology at Pasadena, gave a Sigma Xi address at the Louisiana State University on March 13. His subject was "Cosmic Rays and New Elementary Particles of Matter."

SIR ALDO CASTELLANI, visiting professor of preventive medicine and public health at the School of Medicine of the Louisiana State University, gave two lectures before the students and faculty of the School of Medicine of Yale University on February 28. He discussed "Medical Organization in Tropical Expeditions" and "Mycetes and Mycoses."

PROFESSOR S. LEFSCHETZ has returned from a trip to Belgium, where he lectured on general topics of topology and algebraic geometry, under the auspices of the Belgium American Educational Foundation, at the Universities of Brussels, Ghent, Liège and Louvain.

DR. R. B. STOLTZ, chairman of the department of dairy technology of the Ohio State University, lectured on March 9 before the Lancaster Branch of the American Association for the Advancement of Science. The lecture was entitled "Dairying Down Under" and was illustrated by colored motion pictures and slides of Australia and New Zealand.

A SYMPOSIUM on "The Social Function of Science" was given on the evening of March 10 at a meeting at the American Museum of Natural History of the New York Chapter of the American Association of Scientific Workers. The speakers were: Dr. Franz Boas, professor emeritus of anthropology, and Walter Rautenstrauch, professor of mechanical engineering, both of Columbia University; Dr. Morris Meister, principal of the Bronx High School of Science, and Dr. Vilhjalmur Stefansson, the Polar explorer.

A SERIES of summer conferences on astronomy will be held at the Harvard College Observatory from July 5 to August 15. The program will include courses on stellar astronomy and the following seminars: "Survey of Modern Problems in Celestial Mechanics," "Stellar Structure and Stellar Variability," "Hollow Square Conferences," "Conferences on Special Problems," "Distribution and Motions of the Stars." There will also be opportunities for research under guidance in the fields of stellar statistics, astrophysics, eclipsing binaries and photoelectric photometry. In addition to members of the faculty, the following visiting lecturers will take part in the conferences: Dr. Svein Rosseland, of the Institute of Theoretical Astrophysics, Oslo; Dr. Jan Oort, of the University Observatory, Leyden; Dr. Freeman D. Miller, of Denison University; Dr. Zdenek Kopal, of the University of Prague; Dr. Richard A. Prager, of Berlin, and Dr. E. F. Freundlich, of Prague.

THE eighteenth International Congress of Anthropology and Prehistoric Archeology and the eighth session of the International Institute of Anthropology will be held at Istanbul, Turkey, from September 18 to 25. The general secretary for the congress is Professor Muzaffer Göker, dean of the faculty of languages, history and geography at Ankara, Turkey.

THE Museums Association of Great Britain will hold its fiftieth annual meeting from July 3 to 8 at Cheltenham. The council of the association has invited the American Association of Museums to be officially represented at this meeting. Members of the American association who may be able to attend are requested to communicate with the president or the director. Among the speakers at the meeting will be Lord Amulree, president of the Royal Society of Arts; Sir Robert Witt, chairman of the National Art Collections Fund; Sir Evan Charteris, chairman of the Standing Commission on Museums and Galleries; Arundell Esdaile, president of the Library Association; and E. Foundoukidis, secretary-general of the International Museums Office. Entertainment will include a reception by the mayor of Cheltenham; a reception by Viscount Bledisloe, president of the Museums Association, and Lady Bledisloe; an association reception and dance; and excursions to the Cotswolds on July 7 and to other places of interest near Cheltenham on July 8.

THE twenty-second annual Canadian chemical convention will be held this year in London, Ontario, from June 5 to 8. T. A. Faust, president of Yocum-Faust, Ltd., is the chairman of the local committee, with J. A. Gunton, head of the department of chemistry, University of Western Ontario, as vice-chairman. There will also be meetings of the Industrial and Engineering Section, the Pure Chemistry Section, the Biochemical and the Agricultural Chemistry Section, the Food and Cereal Section and the Chemical Education Section of the American Chemical Society. A new section, Metallurgy and Mining, will be inaugurated. Special attention will be given to a discussion of the possibilities of the wider and better utilization of agricultural products for chemical and industrial purposes, in line with the recently established Chemurgic Council of the Canadian Chamber of Commerce.

ACCORDING to the *Journal* of the American Medical Association property valued at nearly a million dollars was recently given to the City of Atlanta by Dr. Luther C. Fischer, including the Crawford W. Long Memorial Hospital, established in 1908 by Dr. Fischer and the late Dr. Edward C. Davis. Dr. Fischer gave also his 138-acre estate in Chamblee to the same board of trustees, who will handle the hospital for the public. Ten acres of the estate are planted in roses; the gardens are endowed with $200,000 for maintenance. Dr. Fischer stipulated that the hospital must be operated for the benefit of families of modest means, those who are unable to pay the standard costs of hospitalization and unwilling to accept charity, but who will pay what they are able.

THE Rockefeller Foundation has appropriated £650 as a grant to the Cavendish Laboratory for the purchase of instruments and for assistance in connection with researches carried out by the Cavendish professor of experimental physics on the application of x-ray technique to the study of crystals of biological importance.

THE House Appropriations Committee recommended on March 8 the sum of $160,578,905 to finance the work of the Department of the Interior, including the Reclamation Service, the Indian Service, the National Parks maintenance, the Geological Survey and the Office of Education. An increase of $35,000 was recommended for the Bureau of Mines to permit it to carry on experimental and research work in connection with the production of metallic magnesium on the ground that it is valuable for aircraft construction. Some of the principal items in the bill included $50,622,600 for the Reclamation Service, $3,293,000 for the Geological Survey, $2,325,760 for the Bureau of Mines, $20,434,282 for the National Park Service, $16,264,100 for vocational education and $34,132,003 for the Bureau of Indian Affairs. Among other items in the bill is an appropriation of $1,070,000 for the Government-owned reindeer industry in Alaska.

THE Carnegie Corporation of New York has made a gift to the American Association of Museums to provide grants-in-aid for foreign travel and study during the year 1939 by members of the staffs of museums: whose principal duties are of a professional nature; whose salary is not over $3,000; who have not the private means to travel abroad; whose duties in their museums would not normally give them such opportunities; and to whom their institutions will give at least two months' leave on full pay for the travel for which the grant is made. These grants are for traveling expenses to places where the applicant will have an opportunity to broaden his background by familiarizing himself with the institutions, collections or regions of importance in the study of his particular professional subjects. It is planned that the average grant will not exceed $500 except under most unusual circumstances, and that it will not amount to as much as $1,000 in any case. All applications should be sent to the director of the American Association of Museums, Smithsonian Institution, Washington, D. C., before April 15.

THE Westinghouse Electric and Manufacturing Company has agreed to provide support for the science and engineering clubs of the American Institute of the City of New York for three years. The clubs provide an opportunity for young persons of high-school age to take part in scientific work.

DISCUSSION

SAFEGUARDING TYPE SPECIMENS

WITH two serious wars actually in progress in the world and constant threats of others, it is surprising that no general organized efforts have been made to safeguard the irreplaceable type specimens on which botanical nomenclature rests. This is a serious reflection on the breadth of vision of those engaged in systematic botany.

The importance of type specimens in taxonomy is now recognized by all competent systematists. Yet the care of these specimens is entrusted to any herbarium, large or small, in whose possession they happen to be. This is bad enough in the United States, where many institutions are not fully equipped for proper care of valuable material, but it is a crime against botanical science in those countries of the world where wars are being fought or constantly threatened.

With no intention of belittling the valiant efforts of those who have hidden the Spanish herbaria in cellars or of the British institutions which, during the world war, transported valuable specimens to country districts, and which were prepared to do the same during the recent crisis, it seems appropriate to ask why such uncertain measures must be necessary. Material is inevitably damaged during emergency packing and transportation, and in some institutions the task might seem so great as not to be attempted.

Scientists have no right to criticize the common people for having an apathetic attitude toward such important questions as national policies or to hold governments to account for the state of world politics, when their own inertia and provincialism stand in the way of solution of a problem as simple as that under discussion. The safeguarding of the specimens on which scientific language is based is an infinitely easier task than keeping nations out of war.

In the November issue of the *Journal of Botany, British and Foreign,* the writer has presented as a basis for discussion a plan for the preservation of all botanical types. It seems unnecessary here to more than summarize the features of this plan and to call the attention of American botanists to it. Most of those interested doubtless have access to the *Journal of Botany.*

It is suggested that a central herbarium be established for the housing of all types and historically important specimens, in a locality selected as most unlikely to see any future war activity, remote from any possible military objective. Here type specimens could be deposited by all herbaria as gifts, permanent loans or, where loans are forbidden, by establishment in the central repository of an actual branch of the herbarium concerned. Administration would be in the hands of a director and board of regents appointed by the International Congress of Botanists. Loans of specimens would be made freely to accredited institutions. Financing would, at first, necessarily be by assistance of various research foundations and botanical institutions. Gradually an endowment could be built up, and service to the botanical public be expanded. The main immediate objective would be to get all type specimens into a safe, yet accessible place.

Who knows what has become of the young Chinese herbaria, as yet, fortunately, without many types? Who can not imagine what might have happened if the recent European trouble had burst into war? Prague, Berlin, Vienna, Paris and London would certainly have been bombed. The belief has recently been expressed that no nation would waste a bomb on a museum, that any damage would be due to accidents. However, reports have been coming from reliable sources that many important Chinese educational institutions have been systematically destroyed. And the university at Madrid was used as a fortress. Military men should not be the only ones to learn lessons from these "rehearsals."

Types and other historic specimens can no longer be regarded as private property of individuals or institutions, but must be treated as a legacy, entrusted to us by the botanists of the past for the benefit of botanical science, present and future.

Certainly these considerations are important enough to merit discussion. It is to be hoped, too, that nationalism, institutional jealousy and the desire for institutional prestige may, for once, be entirely absent from the discussions. Local discussion is urged on this problem during the next year and a half, with a view to definite action at the congress at Stockholm in 1940.

F. R. FOSBERG

BOTANY DEPARTMENT,
UNIVERSITY OF PENNSYLVANIA

AN UNCOMMON METHOD FOR THE DETERMINATION OF "g"

AMONG the numerous possibilities of determining the gravitational acceleration g, one has found little or no attention. To the writer's knowledge none of the regular physics practica makes use of the conical pendulum for the determination of g, although this constitutes a very instructive experiment with a simple underlying theory.

For the conical pendulum, moving around a vertical axis, an equilibrium exists between the centrifugal force and the gravitational force. It is

$$(1)\ mg = ml\omega^2\cos\alpha$$

where m is the mass of the pendulum, l its length, α the angle which the suspension forms with the axis, and $\omega = 2\pi n$, with n as the number of revolutions per second with which the pendulum rotates. One can substitute

$l \cos\alpha = h$, where h is the vertical distance between the suspension point of the pendulum and its center of gravity. This results in

$$(2)\ g = h\omega^2 = 4\pi^2 n^2 h$$

All that is necessary to perform the experiment is a motor with adjustable speed with the turning axis in vertical position. From the axis a little weight is suspended by a string. Furthermore, a revolution counter has to be attached to the axis. The speed of the motor is adjusted so that the weight swings in a predetermined height h, which can be observed through a telescope, and which is kept constant. Then only the number of revolutions has to be determined over a given period of time. Even with a rather crude set-up reasonable accuracy is readily attainable. If a kathetometer is used for the height determination and a revolution count made over a longer period of time a rather good approximation of g may be obtained.

The method can be refined by controlling the height of the weight and the speed of the motor by a photoelectric cell and by placing the arrangement in a vacuum.

H. LANDSBERG

THE PENNSYLVANIA STATE COLLEGE

FOREIGN JOURNALS IN THE U.S.S.R.

IN a note in your issue of December 6, 1935, I compared the numbers of three British journals going to the U.S.A. and the U.S.S.R., respectively. In spite of the reiterated claim that scientific persons are treated more liberally in the U.S.S.R. than in any other country, and that the Soviet Union leads the world in its expenditure on and attachment to science, it appeared that in the United States *government and private effort together* obtained nine times as many copies of three important foreign scientific journals as in the Soviet Union.

It is possible that this comment did some good, for in the meantime the ratio has fallen from 9 to 4. Improvement is still necessary, for science can not be prosecuted without knowledge of what other people are doing, and the Soviet Union should need at least as many foreign journals as the U.S.A., since personal contact of its workers with foreign scientists is impossible. If the ratio (purchases by U.S.S.R.)/(purchases by U.S.A.) rises uniformly with time, it will become unity in about 1956. By then also it may be possible for scientific research workers in the U.S.S.R. to visit their colleagues in other countries. At present apparently it is not possible, for in spite of the evident attachment of the Soviet Union to physiology—not one physiologist was permitted to attend the International Congress of Physiologists last summer, nor even to answer the invitation.

Table 1, however, gives one hope of better things:

TABLE 1

	U.S.S.R.	U.S.A.	Ratio: per cent.
November, 1935			
Journal of Physiology	27	241	11.2
Journal of Experimental Biology	7	130	5.4
Biochemical Journal	47	374	12.6
Total	81	745	11.9
February, 1939			
Journal of Physiology	52	268	19.4
Journal of Experimental Biology	27	136	19.9
Biochemical Journal	126	390	32.3
Proceedings of the Royal Society A	25	191	13.1
Proceedings of the Royal Society B	15	146	10.3
Total	245	1,131	21.6

A. V. HILL

UNIVERSITY COLLEGE,
LONDON

THE MANIFESTO BY A PHYSICIST

No one can read Professor Bridgman's "Manifesto by a Physicist" in the February 24 issue of SCIENCE without being profoundly impressed by the sincerity and high purpose of the author. Nor will any one doubt that his decision to close his laboratory to citizens of totalitarian states was taken "only after the gravest consideration."

One hesitates to call in question the carefully considered action of one of the most distinguished ornaments of American science, a man internationally known not only for his contributions to physics but also for his writings on the philosophy of science. Nevertheless, I venture to express the hope that few scientists in America and other democratic countries will follow Professor Bridgman's lead. I do this because of serious doubts respecting the efficacy of the procedure, its propriety, its justice and its wisdom.

It is difficult to see how such demonstration of hostility to the totalitarian conception of the state and the place of science in the state can be effective of great good. The detestation of democratic peoples for totalitarian ideas has long been proclaimed from the housetop. To express it in the laboratory can not add greatly to the weight of public opinion marshalled against the totalitarian régimes. Humiliation of visiting scientists, especially when it is visited upon the innocent as well as the guilty, must breed resentment against the behavior of scientists in the democracies.

Would not envy of them be more productive of action in the direction we wish? The scientist from Germany, Italy, Russia or Japan who visits our laboratories and observes the freedom in which we work can not but compare our liberty of action with the strait-jacket into which his government has put him, his colleagues and his students. Will not such visitor return to his land a more effective missionary for human liberty than one who has encountered only humiliating rebuffs?

The propriety of excluding visitors from scientific laboratories and other spheres of scientific activity, solely on the ground of citizenship in a totalitarian state, seems open to question. It is not in the tradition of science to make political, economic or religious beliefs and behavior a test for entrance into scientific cooperation. One of our chief indictments against the totalitarian states is that they have degraded science by subordinating their laboratories and their lecture halls to political control and to political uses. Can we then with propriety open or close our laboratories and our lecture halls for political purposes, even when those purposes to us seem meritorious? Is there not, on the contrary, a fundamental impropriety in mixing politics with science, whether this be done in a totalitarian or a democratic state?

It is difficult to see how visitors can be excluded from our scientific laboratories, *solely on the basis of citizenship in a totalitarian state,* without perpetrating frequent and serious injustice. It will be noted that the views of the individual visitor are not the subject of attack. It is the policies of his country that are to be punished in his person. From personal acquaintance with scientists in all the totalitarian states I can testify that by no means all of them are active exponents or even willing victims of totalitarian ideologies. Some I know, and many more I believe, both hate and fear the governments they are forced to serve. Not all can emigrate, and when home and family may be involved in ruin, it is not easy to avow one's beliefs and become a martyr to one's principles.

To exclude such men from the fraternity of science solely on the basis of their citizenship is to punish the innocent for the crimes of the guilty. The plea that only thus can we bring pressure to bear upon the guilty does not sufficiently commend the procedure. When Germany delivered innocent Jews to massacre and pillage because some Jew in a foreign land had been guilty of assassinating a German official, the civilized world cried out in horror. Comparison between such inhuman slaughter and spoliation, and the relatively mild action of excluding citizens of totalitarian states from scientific laboratories, is admittedly remote. But the fundamental principle underlying both procedures was avowedly the same: to bring pressure upon those otherwise beyond effective reach, by punishing, regardless of their individual innocence or guilt, those whom circumstances place within our power.

There would be more justice in such action were the circumstances reversed and were scientists in the totalitarian states to exclude American visitors from their laboratories because the American government had adopted policies harmful to science. For in a democracy the citizens are responsible for the government they place in power. But who will pretend that citizens of the totalitarian states are responsible for the acts of their governments? When bullets replace ballots in government, the responsibility as well as the freedom of the citizen is extinguished.

Even were there a measure of justice in the proposal under discussion, the wisdom of such action would still remain in question. If it be right for scientists to close their laboratories to citizens of totalitarian states, it is right for editors of scientific journals to close their columns to contributors from such states. It is not easy to see why exclusion from the lecture-room and the seminar should not follow. This would put not only science but also our universities and other centers of research and teaching into the political arena for the purpose of combatting a system of government harmful to science. The object in view seems to me commendable; but is the method wise?

It may be argued that the act of exclusion is intended to keep politics, and particularly a bad political philosophy, out of science and out of the university: and Professor Bridgman was careful to say that his statement regarding exclusion was made in his capacity as an individual and that it had "no connection whatever with any policy of the university." As to the first point, publication of the exclusion policy in this country and abroad will almost certainly make the action a factor in international politics, especially if scientists generally follow Professor Bridgman's lead. Indeed, the essential reason for the action is to accomplish a political purpose: to help "make the citizens of the totalitarian states realize as vividly and as speedily as possible how the philosophy of their states impresses and affects the rest of the world." Surely science will find itself involved in a peculiarly angry type of international politics if scientists in large numbers restrict access to their laboratories, observation of their apparatus and discussion of their experiments, for the express purpose of accomplishing the objective quoted.

Such action must inevitably involve the university as well, unless the laboratory is the personal property of the scientist and located outside university grounds. The individual professor can not use university property (whether it be laboratory, lecture hall, stationery or official title) for political or other purposes without involving the university in his activities. This fact has long been recognized by university authorities, and is a common cause of restrictive administrative regulations. A given university may for various reasons approve a specific act of the kind under discussion, or may grant its officers wide latitude in the exercise of discretion. But the question remains: Is it wise for the university, the traditional home of intellectual liberty and untrammeled search for truth, to become involved in acts of exclusion designed to effect political ends?

To the writer it seems most unwise, even dangerous, to make university halls and scientific laboratories in any degree the base for political action. For sound reasons a scientist may bar this or that obnoxious individual from his classroom or his laboratory. But the reasons should apply to the individual, not to a nation; and they should be such as would cause him to exclude an American as quickly as a German, an Italian or a Russian. Science itself is imperilled far more than is any hateful political system when those engaged in the search for truth utilize courses of scientific instruction, scientific laboratories or scientific journals as weapons in political warfare.

In closing let me emphasize the fact that what I have written is in no sense a plea for toleration of totalitarian ideology. I am not among those who believe that it is a Christian duty to regard with toleration things which are utterly intolerable. And surely nothing could be more intolerable than the enslavement of the human spirit practiced under the totalitarian form of government! What I have done is to record my plea that scientists fight political battles with political weapons, and that they do all within their power to keep our academic halls and research laboratories sheltered from political storms, safe havens of intellectual sanity, calm judgment and free search for truth in a world gone mad.

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SCIENTIFIC BOOKS

INSULIN

Insulin. Its Chemistry and Physiology. By HANS F. JENSEN. New York: The Commonwealth Fund. London: Oxford University Press. 1938. Pp. 252.

IT may be stated immediately that Dr. Jensen's book is an excellent one. More than ten thousand reports on insulin have been published since 1922, and an adequate study of this subject now touches upon many aspects of physiology and of protein chemistry. For this reason it is extremely difficult for one author adequately to cover all aspects of the subject, but Dr. Jensen has enlisted the aid of experts in physiological matters, and he, himself, is admirably suited to discuss the problem from the chemical view-point. By the same token, it is expedient for the reviewer to secure opinions from his colleagues who have worked along lines on which he is less competent to comment. One is happy to find that the chemists who have been consulted and who have first-hand knowledge in this field are very enthusiastic about Dr. Jensen's contribution.

In the first chapter an accurate and concise account of the history of insulin is given. In the second, the various methods for the preparation of the hormone are described, and a table showing the yields of insulin secured by the various procedures is given. Here it may be remarked that, as many of the reports express the yield in terms of some absolute unit, results can not be accepted at their face value. The general trend, however, is clear. The preparation and chemistry of crystalline insulin is then discussed. What would appear to be a mistake in a date will be found in the preface, where it is stated that crystalline insulin was prepared in the year 1922. The report of this work was, of course, published in 1926. The fourth chapter deals with the standardization of insulin and is very well handled; the fifth deals with its administration, and the sixth with substitutes for insulin. Here the author gives more prominence to "Duodenin" and "Incrétine" than the reviewer would be prepared to do. The author remarks that it is probable that "all these workers were dealing with the same substance in spite of differences noted in the effect on depancreatized animals." An equally probable interpretation is that none of the workers were dealing with any active substance. The last chapter deals with the physiological action of insulin and provides a very useful review of this phase of the subject.

It has not been possible in the space available in this book to discuss in a comprehensive manner all the aspects of the situation. One feels that this volume should provide an excellent text for students and that lectures on the chemistry and physiology of insulin could well be based on it. For some courses the book would be adequate, for others it would have to be supplemented by more detailed comments.

There are a few places in which the author has made an interpretation of the results which differs from that which the reviewer feels is correct. This merely means that there are still many problems associated with insulin which have not as yet been settled.

The book is well written, the pages are of a convenient size and the type is good. The bibliography and the author index have been, with a few exceptions, carefully prepared and add greatly to the value of the publication.

C. H. BEST

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MATHEMATICAL SNAPSHOTS

Mathematical Snapshots. By H. STEINHAUS. G. E. Stechert and Co., New York[1] (printed in Poland; profusely illustrated), $2.50.

THE only way to review this beautifully made book is to describe its rich and extraordinarily varied content in some detail. It is mathematical recreations at a new level of simplicity, interest and unusualness, somewhat reminiscent of Lucas at his best, but less formal. Each page has one or more excellent illustrations, some in two colors, and a pair of colored spectacles is provided for use with the anaglyphs. The pocket also contains a colored self-folding dodecahedron and a set of cards for mathematical movies. Perhaps "visual mathematics" describes the general character of the recreations. Wisely, the author has refrained from attempting to teach anything, although any one who can turn the pages without learning something must be singularly stupid. As in all good recreations, the concealed mathematics sometimes lies very deep. In this sense the book is scientific. But it can be enjoyed by any one with a grammar-school education.

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[1] The Polish copyright date, pasted over, appears to be 1936.

As the contents are so unusual, we give a partial summary of the topics touched so lightly and so effectively by the author (who, by the way, is a distinguished mathematician). We find: dissections of rectangles; noughts and crosses; the slide rule; chess problems, Euler's 36 officers, the 15 puzzle; musical scales; simple nomograms; the golden section, Fibonacci's sequence and phyllotaxis; tesselations; the triangle of forces; Peaucelier's linkage; anaglyphs; straight-edge constructions, roulettes, cams; Minkowski's lattice theorem; the limaçon, conics, the tractrix; space-filling curves; the regular solids, crystals, densest packing, soap-bubbles; orthodromes and loxodromes; ruled surfaces; the resolution of cusps on skew curves; topological problems—unicursal patterns, the bridges of Konigsberg, knots, Möbius' strip, existence of a bilateral surface with a knotted edge, the map problem for a torus; Pascal's triangle and the "board of fortune," the Gaussian distribution—amusingly illustrated by an experiment on digitalized frogs, which inspires the author to rechristen the normal curve "the frog-line"; the law of biologic growth, and finally, a somber mortality graph for the U. S. in 1910. Scholarly historical and mathematical notes (184) conclude this most fascinating book. It should perform a genuine service by popularizing mathematics.

E. T. BELL

SPECIAL ARTICLES

CHARACTERIZATION OF GONADOTROPIC HORMONES OF THE HYPOPHYSIS BY THEIR SUGAR AND GLUCOSAMINE CONTENT[1]

CHEMICAL purification of the anterior pituitary hormones has been impeded by their protein nature and by time-consuming bioassays. In the case of the gonadotropic hormones, the situation is further complicated by their established interrelations. Chemical differences in these hormones traced by quantitative analytical routine would naturally prove a boon in purification efforts. Thus the purification and crystallization of insulin speedily followed the discovery of the high sulfur content of this hormone.

It has recently been found[2, 3, 4] that gonadotropic preparations from the pituitary as well as from other sources are rich in *carbohydrate*. We therefore determined the carbohydrate content (orcine method) of the 40 per cent. alcohol extracts of acetone dried sheep pituitaries which served as our starting material, and of purified FSH and ICSH fractions prepared therefrom. The method of fractionation was based on salting-out procedures[5] and subsequent acid-acetone fractionation. When assayed in our hypophysectomized female rats the total M.E.D. of the best FSH and ICSH preparations was between 0.005 mg and 0.01 mg. The starting material contained about 9 per cent. carbohydrate. FSH fractions have a high carbohydrate content (10.3 to 13.1 per cent.) increasing with purification; ICSH fractions[6] a conspicuously lower carbohydrate content (5.4 to 3.6 per cent.), decreasing with purification. All other available hormone fractions from the pituitary showed a low carbohydrate content (see table 1). Although, as mentioned, FSH fractions have an increasing carbohydrate content with increasing purity, a high carbohydrate content in any pituitary fraction can not be taken as a measure of its FSH potency, for inert proteins isolated from FSH mother-liquors had a content of 19 per cent. carbohydrate.

In search for a more specific chemical characterization of gonadotropic hormones, *glucosamine* was determined by the Elson-Morgan method. Gonadotropic fractions contained more glucosamine than any other pituitary preparations investigated. Glucosamine increased with the increasing purification of both FSH and ICSH. The best FSH contained 8 per cent. glucosamine, ICSH 3.8 per cent., while inactive fractions contained approximately 3 per cent., thyrotropic hormone approximately 3 per cent., growth hormone 1.8 per cent. and lactogenic and adrenotropic no glucosamine. Thus glucosamine determination may well be taken as a measure of gonadotropic potency in pitui-

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[1] Aided by grants from the Board of Research of the University of California and Rockefeller Foundation of New York.

[2] M. Hartman and F. Benz, *Nature*, 142: 115, 1938.

[3] G. Fleischer, E. Schwenk and K. Meyer, *ibid.*, 142: 835, 1938.

[4] S. Gurin, C. Bachman and D. W. Wilson, SCIENCE, 89: 62, 1939.

[5] H. Jensen, M. E. Simpson, S. Tolksdorf and H. M. Evans, *Jour. Biol. Chem.* (in press).

[6] Attention must be drawn to the very striking difference in the carbohydrate content of pituitary ICSH (3.6 per cent.) and of chorionic ICSH—that in pregnancy urine (ca 18 per cent.).

TABLE 1

Pituitary fractions	Carbohydrate, per cent.	Glucosamine, per cent.
40 per cent. Alcoholic Extract of Sheep Pituitary Powder	9.2	3.0
FSH		
(IF66A)	13.1	8.1
(IF18)	10.3	7.8
ICSH		
(L49B)	3.6	3.8
(L45DI)	5.4	5.8
Thyrotropic hormone		
(Schering)	2.9	3.5
(U89OK)	1.2	2.5
Growth hormone		
(DAP14)	2.7	1.8
Adrenotropic hormone		
(L16A4)	0.41	0
Lactogenic hormone		
(L16L4)	0.25	0
Inert globulins	3.6	2.7
Inert albumins	19.1	3.7

tary fractions and may prove a useful tool in the purification of these hormones. On the other hand, the absence of glucosamine in our adrenotropic and lactogenic preparations is important further evidence that gonadotropic hormones do not contaminate these preparations.

While from the foregoing it is evident that carbohydrate determinations alone will not differentiate gonadotropic from other pituitary fractions, they are extremely useful when employed in conjunction with glucosamine determinations. Thus, glucosamine content enables one to differentiate between gonadotropic and other fractions from the pituitary, while carbohydrate content gives the clue as to the particular gonadotropic fraction with which one may be dealing. Though future research may modify the values for either hormone, we can safely state that a glucosamine-rich pituitary fraction will be mainly FSH if it contains more than 12 per cent. carbohydrate, and mainly ICSH if it contains less than 4 per cent. of the latter.

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A SELECTIVE ACTION OF URINE AND SERUM FROM PATIENTS WITH MALIGNANT TUMORS ON EMBRYONAL AND NEWLY GROWING TISSUES

Some two years ago there came for examination a young man of twenty-four, who had a tumor, a large embryonic cancer, of the right testicle. His urine, injected into a virgin rabbit, gave the characteristic Ascheim-Zondek reaction. The tumor was removed, and for about a month the reaction was absent. It then returned and with the appearance of metastases later on, the reaction became stronger. Being curious to see what effect this patient's urine would have on the ovaries, 20 cc were injected daily, intravenously, into a 12-day pregnant rabbit. On the fifth day the animal aborted. As this was unexpected, the urine was injected into three other pregnant rabbits, with the same result as in the first.

It was thought that the embryonic character of the tumor was the important factor, and accordingly urines of patients with tumors of corresponding types —dysgerminoma of the ovary, teratoma of the testicle and the Wilms tumor—were tested. These all produced abortion. The urines of a large number of patients with other types of malignant tumors were then tested, and in all instances abortion occurred, usually within a period of five days. Blood serum of patients whose urine had the abortifacient effect also was effective. As a control the urine or serum of a considerable number of normal individuals and ward patients free of malignancy was injected, with negative results.

The uterine changes which are produced are striking. With daily injections of the urine, there occurs, starting at the inner border of the decidual cells, a progressive placental necrosis associated with infiltration of inflammatory cells. The zone of necrosis becomes increasingly broadened until it involves the entire embryonal mass on the decidua. With the removal or absorption of the foetal structures, the uterus eventually returns to a normal state. The foetus in its early period undergoes rapid loss of its structural form. In late pregnancy it is expelled without marked change in its structure.

In addition to the action of the urine on the placenta and foetus other effects have been noted. When injected into non-pregnant rabbits, changes were found in the ovaries. These consisted of definite degeneration or destruction of the graafian follicles, especially in the granulosa cell portion, the ovaries finally becoming small and sclerotic. Further, when injected into male rabbits, the testicles showed degeneration or complete absence of the spermatogenic processes.

In some other experiments the urine was injected into rats which had been grafted with No. 256 Walker carcinoma. The usual course of such tumors is that after a certain period of growth, necrosis and sloughing occur, this beginning centrally and only gradually extending to the periphery. The process is not of a hemorrhagic nature but of a suppurating type. In the urine-treated rats a different picture was seen. Necrosis occurred, but, instead of beginning in the center of the tumor, began at the periphery and involved not only the cancer cells but also the epithelium of the newly formed blood vessels.

It would seem, then, that the urine and serum of patients with malignant tumors have a selective destructive action on embryonal or newly growing tissue.

We have not had opportunity for intensive study of the substance responsible for the effects described. It is possibly related to hormone activity, but there is no hormonal action we are aware of which produces these effects. As has been stated, the urine originally used gave the Ascheim-Zondek reaction. That this special property was not concerned with the abortifacient action was shown by the lack of effectiveness of the urine of pregnant women which gave the reaction. In carrying this line of work further, massive doses (500 units daily) of anterior pituitary Antituitrin S together with estrogenic hormone (20.000 units) were injected into pregnant rabbits. Abortion did not occur.

Work is being continued on the many interesting problems which arise in connection with it.

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SPLITTING PROTEINS BY ULTRA-VIOLET LIGHT

THE experiments of Rideal and Mitchell[1] have shown that stearanilide $C_6H_5NHCO(CH_2)_{16}CH_3$ undergoes photolysis when exposed to light as a monomolecular film, giving anilin and stearic acid. The –NHCO– group is the common peptide linkage of proteins and at first sight one might expect the stearanilide experiment to apply directly to protein splitting; however, in the amino-acids the side-chain carrying the benzene ring or other light-absorbing groups, is attached through a CH_2 group to the α-carbon atom of the acid. This means that the absorbed light quanta must travel from the ring through two CH_2 groups before it may activate the NH_2 group and cause a reaction.

In testing the possibility of such a transfer of energy from the ring to the chain, the writer has prepared benzyl stearyl amine $C_6H_5CH_2NHCO(CH_2)_{16}CH_3$, and β-phenyl-ethyl stearyl amine $C_6H_5(CH_2)_2NHCO(CH_2)_{16}CH_3$ and subjected mono-layers of each on N/1 hydrochloric acid solution to ultra-violet light of wavelength 2480 and 2537 Å, through filters. Photolysis of each compound is easily demonstrated in the properties of the film and by the reaction products. It is therefore to be expected that the peptide chains of proteins may be split at places where light-absorbing side-chains occur in the molecule. By irradiating a protein with a suitable wave-length of light, splitting can presumably be directed to points in the peptide chain adjacent to a side-chain carrying a given light-absorbing group. Svedberg and Brohult[2] have recently reported the splitting of haemocyanin by light in the region of the absorption band around 2750 Å.

The above-mentioned experiments are not to be confused with the photolysis of amino-acids in general which give ammonia and the corresponding hydroxy-acid.

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[1] *Proc. Roy. Soc. London*, 159: 206, 1937.

[2] *Nature*, 142, 830, 1938.

VITAMIN B_1 IN CEREBROSPINAL FLUID

THE vitamin B_1 (aneurin, thiamin) content of cerebrospinal fluid has not heretofore been reported. W. Karrer was unable to detect aneurin in this fluid, using the thiochrome reaction of Jansen.[1] However, we have obtained positive results in most of the fluids examined by adopting a slight modification of Westenbrink's technique for urine.[2] The values encountered in 30 cases belonging to various mental diseases (epilepsia, dementia praecox, paraphrenia) averaged 2.5 γ per cent. The technique employed was briefly as follows: the sample was acidified to pH 4.0 with acetic acid and adsorbed on frankonite. The adsorbate was washed and dried at 100° C. The powder was divided in two portions. Graduated amounts of one portion were added to a series of test-tubes containing synthetic media which were then sowed with fresh spores of *Phycomyces blakesleeanus* and determined by the method of Schopfer and Jung.[3] The other portion was eluated and oxidized with potassium ferricyanide and the thiochrome extracted with isobutanol. The fluorescence obtained was compared with a standard under ultra-violet light in a Zeiss photometer. The Phycomyces test showed higher values than the thiochrome test. In all cases in which the chemical test was negative, it was possible to detect the vitamin with the Phycomyces test. The cerebrospinal fluids were kindly sent to us by Dr. H. Linhares, of the Psychiatric Institute of the School of Medicine.

All the tests were made with 10 to 15 cc of fluid. Two cases (catatonia and depressive state) showed the highest values, but in other cases (myxedema with cretinism and epilepsy with dementia) no trace of aneurin could be found by either test.

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[1] W. Karrer, *Helv. Chim. Acta*, 20: 1147–1155, 1937.

[2] W. G. K. Westenbrink and J. Goudsmit, *Arch. Néerl. Physiol.*, 23: 79–96, 1938.

[3] W. H. Schopfer and A. Jung, *Zeit. Vitaminforsch.*, 7: 143–152, 1938; and G. G. Villela, O Hospital, 13: 43, 1938.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A NEW DISSECTING APPLIANCE

LAST fall I found one of my comparative anatomy students (name withheld by request) using a very simple and convenient device for holding his dogfish open while dissecting. It consisted merely of an elastic band with a bent pin attached to each end, making it possible to attach one hook, carry the band around the dorsal side of the animal and hook it to the cut flap of the body wall on the other side. With a little improvement I am offering the idea to the readers of SCIENCE as a convenient and inexpensive dissecting device.

With a small pair of round-nosed pliers the head end of a common brass pin can be bent into a loop and closed over one end of an elastic band. Half an inch of the pointed end is then bent into a hook and with a second pin at the other end the device is complete. Three or four hooks may be attached to a large elastic band if desired or bands may be tied or looped together. The sketch, Fig. 1, shows how it is made.

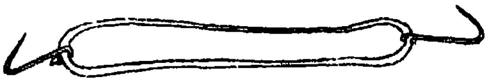

FIG. 1

Pins may be had up to 1½ inches in length or wire from paper clips may be used if large rubber bands are wanted.

The elasticity of rubber makes it particularly useful in holding back the cut flaps of the body wall while working and I like it much better than the chain hooks that are sold for the purpose. It can also be used to hold the body together when the animal is put back into the formalin tub, for if brass pins are used they will not rust.

PHILIP H. POPE

WHITMAN COLLEGE

SATISFACTORY SUBSTITUTE FOR SODA LIME IN RESPIRATION CALORIMETRY

IN a long experience with soda lime as an absorbent for CO_2, in respiration calorimetry, this laboratory never succeeded in permanently solving the practical problem of obtaining this preparation in satisfactory quality, the difficulty having been to get a product of uniformly high efficiency and one in which saturation with CO_2, and the coincident drying of the soda lime, would cause a definite change in color of the material. The results have been much waste of time and of soda lime, uncertainty of mind on the part of the worker and occasionally inaccurate results. This experience has been a common one in other laboratories.

A year ago the author suggested a substitute for soda lime which proves to have very much greater capacity to absorb CO_2, which changes color conspicuously as it comes to be exhausted and which is cheap and reliable.

This preparation is a 40 to 60 mixture of flake sodium hydroxide and granular pumice stone. It is important in the use of this absorbent, in a Schwartz U tube, to fill the hollow of the stopper of the stopcock on the incoming side with wet absorbent cotton.

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A METHOD FOR OBTAINING A CONTINUOUS MEASUREMENT OF SOIL MOISTURE UNDER FIELD CONDITIONS

A METHOD has been devised for making *in situ* under field conditions a continuous measurement of soil moisture. It consists of imbedding in the soil a standardized block of $CaSO_4$ (gypsum). The moisture content of this material varies directly with that of the soil. Since the dielectric constant of gypsum is proportional to its moisture content, a measure of the conductivity of the block is a measure of soil moisture. Conductivity determinations are easily made by means of electrodes and a form of the Wheatstone bridge.

This device measures soil moisture ranging from the wilting point to the field capacity or it is really a measure of the available water. It denotes the wilting point accurately. By knowing the wilting point and the available water, the total water content is thereby also known. The method possesses a surprisingly high degree of accuracy.

GEO. J. BOUYOUCOS
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SOME THOUGHTS ON THE PROBLEM OF PROGRESS AND DECLINE[1]

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THE privilege of delivering this address comes to me in the midst of intensive work in fields somewhat removed from the ordinary domain of anthropology, and that is why I have to offer you merely "some thoughts" on a great subject instead of the carefully formulated presentation which it should properly demand. Much of what I have to say will fall in the realm of general theory rather than that of science proper, and this must be my excuse for seeming to intrude into the territories of other disciplines. It would be more than presumptuous in me to do this if the question at issue concerned matters of fact, but it is otherwise when deductions are made from facts which transcend the boundaries of science as ordinarily conceived, and may become bases for attitudes in the world at large affecting the lives of thousands of human beings.

First, I wish to say a word about that naive materialism which was more in vogue perhaps before the birth of the new physics than it is to-day. There is still a popular illusion that because science teaches that a physico-chemical world was necessary before organisms could exist upon it, and because paleontology has demonstrated that organisms have appeared successively in more and more complicated forms, therefore the organic came *in toto* out of the inorganic, and each succeeding level of organic life *in toto* out of the preceding one. Now, the observations of succession and relation are scientific; the deductions as to origin are philosophic. Yet superficial thinkers shift from one to the other without appearing to realize that they have made a fundamental change and an unprovable deduction. Although widely attributed to science and made the basis for that trite remark, "the materialism of science," this deduction never has been a part of science. Nevertheless, astronomers who insist on treating organic life as a rare phenomenon contribute to the error because life is made to appear as an abnormal intruder into the universe, when, in fact, the argument is entirely inferential, based on the assumption that life can exist under no other conditions than those which limit it on a single planet. Of course the anthropologist may have the last word, while granting all that the inorganicist demands, because he may claim the inorganicist himself. The latter may look out into a cosmos seemingly devoid of life phenomena, but the anthropologist can remind him that the observer himself is it, and that he views the heavens through instruments created by such organisms, that his sensory organs and nervous system belong to one, and that what he sees and the deductions he draws are all conditioned by the past history of his race and of his science, by his training and by his personal beliefs and prejudices.

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[1] Address of the Vice-president and Chairman for Anthropology, American Association for the Advancement of Science, Richmond, December 29, 1938.

> When me they fly, I am the wings;
> I am the doubter and the doubt.

The anthropologist may, therefore, obtain some final compensation for being regarded as a somewhat crude interloper into the well-beformulated preserves of the "exact" sciences. In the last act he can claim them all. I am indulging in this philosophic prelude, however, without any such grandiose object in view but merely as a kind of anthropological declaration of independence.

If I seem to detect a philosophical slip on the part of inorganicists in insisting upon the priority of the objects of their study, I believe I detect another in their treatment of cosmic history. As far back as I can remember, and with almost complete unanimity, they have saddened my mind and disturbed my digestion with the spectacle of a running-down universe. To be sure, the general foreclosure is placed at a rather comfortable distance ahead and the new physics has granted very extensive reprieves, even if not a wholly new deal, but apparently not all inorganicists are willing to put the skeleton entirely back into the closet. They will suggest, like Eddington, that there is a monster on our trail known as the second law of thermodynamics which there is no way of shaking off, and that the universe with us poor mortals on its back is running down a blind alley where the monster will certainly corner us and dispose of us at last by a general freeze, unless some star comes along beforehand and gives us the merciful alternative of death by cremation.

But however scientifically justified the "heat-death" concept may be, it is philosophically unsound as a *total* explanation. This is no cavalier assertion of mine. It was demonstrated by Professor Josiah Royce, of Harvard, for instance, long ago, though the special form of the theory in his time was somewhat different from that current to-day. Any one wishing to examine his argument at length will find it in Chapter X of his "Spirit of Modern Philosophy." But, in brief, we can not imagine ourselves to be existing in a fragment of finite time balanced between an infinite period of running-down and an infinite period of stagnation consequent upon the diffusion of energy. If the period of approach were infinite, it would have no end. If the period of stagnation were infinite, how could it have a beginning? We must either suppose we are looking out upon a one-way street and somewhere there is another one-way street carrying celestial traffic in the other direction or such phenomena are tidal and the present ebb will be followed by a flow.

At first sight the biologists seem to be more encouraging than the inorganicists, for organic evolution suggests progress and even as dour a member of the guild as Hooton talks hopefully of it as a movement "up from the ape"—parasitic forms of course excepted. But the eugenists, and Professor Hooton along with them, soon shatter our self-complacency again and plunge us back into the slough of despond, for it seems that the biological advance which our animal and early human ancestors attained is being thrown to the dogs —or even farther—by the perverse refusal of scientists and members of other superior classes—if there are any others—to reproduce their kind. The only point on which they leave us in the dark is as to how many of them are to perform this genetic miracle on the prevailing incomes.

But here again I seem to find flaws in the argument. We are led to believe that there is danger that we shall be overwhelmed with morons on account of the selfishness of the better classes and the recklessness of the worser ones in the matter of reproduction, and because natural selection and the survival of the fittest have been interfered with. But by the same token we must assume that natural selection has done its full duty by our animal relatives, the anthropoids. Yet, after half a million years or so the biologically virtuous anthropoids are on the verge of extinction, while mankind, though he has tampered with his environment in the most shameless manner, has managed to spread over almost all the globe. In the face of this fact, however, we are told that human generation like the universe at large is on the down grade and there is no salvation except in sterilization and in selective birth-promotion, genetic devolution being irreversible. We seem, indeed, to have here a kind of biological Calvinism, a new doctrine of total depravity.

But does it not seem incredible that the relatively small number of our first human ancestors—highly selected, it is presumed, up to the fatal moment of becoming human—could have brought with them across from the animal world such multitudes of germinal defects? And if they did not, certain defects must have been acquired since that time, they are, *ipso facto*, not original or immutable, and there seems to be no good reason to suppose they are beyond treatment. While conceding that some genetic strains may be so far gone in depravity that they had best be eliminated, I can not therefore deny myself the hope that defects of others are curable. There is no surer way to fail than to postulate failure. "It can't be done" in the mouths of people is often the only reason why it hasn't been done.

There is a great deal to be said for eugenic theory, as I think all anthropologists will admit, but it has been made the starting point for all sorts of fantastic attempts at race betterment and genetic determination as far removed from scientific sanity as can well be imagined. In particular, there is a variety of eugenism abroad which not only believes in regulating human generation but believes it possesses the wisdom to do so above all scientists and that virtue consists in the production of human beings of a particular racial type, Nordic or Mediterranean or some other of supposed superior quality.

As has been repeatedly pointed out, there is no historical or biological justification for such a dogma, and hybridization, when not too wide or involving a psychological shock, seems to have proved of more advantage to mankind than the production of purer strains, while those peoples who gave birth to the higher cultures were very diverse. If we contemplate the six or seven centers from which civilization appears to have sprung, we find that the Egyptians, Cretans and probably the people of the Indus valley were dolichocephalic as well as the Semitic element in the Tigris-Euphrates valley, but that the Hurrians, Sumerians, Chinese and Maya were prevailingly brachycephalic, both types occurring in Peru. It is significant furthermore that all these pioneers in the civilizing process belonged to the swarthy races. If Negroes are not represented among them, neither are Nordics, and both are probably absent for the same reason, because they are side-branches of the human family and removed farther from the primary cultural centers. Or are the extreme blacks and the extreme whites both inferior to the rest?

Language is, of course, a cultural feature, but it is one of the more persistent features and is often popularly confounded with race in discussions of racial differences, superiorities and inferiorities. Now, in the culture centers just enumerated, aside from the language of the Cretans, the exact nature of which is unknown, the languages spoken—Egyptian, Semitic, Dravidian, Chinese, Maya, Quechua and Yunca—are, with the possible exception of the first two, totally unrelated and differ completely in structure. Thus both in physical type and in language the peoples who made the earliest cultural advances in both the Old and the New Worlds were diverse, and it may be added that peoples more closely related to each in both particulars remained on a lower level.

Since a dense population seems to be demanded by modern dictators as an adjunct to an aggressive policy, it may be noted that two centers, China and India, have such enormous populations without any aggressive policy to motivate them, and that the centers farther west which developed such a policy, notably those in the Tigris-Euphrates valley, lost. In the New World, Peru, which had a dense population for this continent, did develop an aggressive policy, but the Maya did not. On the other hand, we have numerous cases of aggressive empires, such as those of the Arabs, Romans, Huns and Mongols, which ultimately lost rather than gained.

The relation of civilization to various forms of government is especially pertinent. Offhand one would say that a stable government which gathers under itself all related people in a particular area would be more likely to advance in civilization and to advance civilization than a weak government and divided authority. This expectation is in some measure realized. The Victorian Age in England was one of great intellectual activity and productivity, and so were that of Louis XIV in France, the late sixteenth century in Spain and the Augustan Age in Rome. But, strikingly in contrast in every particular, are Greece of the fifth century B.C., Italy of the Renaissance, the Low Countries in the early seventeenth century and Germany in the age of Goethe and Schiller. Thus the highest spots in intellectual productivity until very recent times have been reached in countries divided into small competing states.

This is not to deny that governments are able to contribute to cultural advance but to point out their limitations. We are here brought face to face with the question of regimentation, to what extent and in what directions it is of value. For regimentation of some sort there is certain to be as long as men are brought together in societies and attempt collective activities. One type of regimentation which is now being very much discussed is, indeed, as old as human society. It is the kind of regimentation which lays upon each member of the group the duty of supplying food, clothing and shelter to all. Most primitive communities are mutual insurance companies and very effective ones. The food-gatherers of the group, using the term food-gatherers in its broadest sense, are not permitted to monopolize the products of their industry and drive bargains for their surplus with other members of the community. Distribution of food is expected and enforced. This might be thought the occasion for an unhealthy crop of drones, and many do exist, but it is doubtful whether the proportion is any greater than in European society. Group opinion is everywhere the most powerful deterrent to dissenters, and members of the relatively small groups of which primitive societies consist are past masters of the art of making non-conformists miserable. The successful hunter will not raise his social status by cornering the food market and by "holding up" other members of the tribe in times of scarcity, but through the credit he receives as the savior of the town. Competition in the monopolization of values does not exist, but instead emulation in the performance of services. This does not mean that individuals in primitive societies are better or more unselfish than those in our own, merely that conditions have enforced upon them the desirability of mutual insurance for the basal needs. Our own society is often obliged to perform these same services, though usually in indirect ways, and we are not able to bring the same social pressure to bear effectively on all hoarders alike.

A regimentation like this which has for its object the care of the underprivileged is, thus, one of respectable antiquity and current utility. It needs no apology. The regimentation which we observe to-day under dictatorial governments, while performing this function incidentally, is of a very different type and motivated to different ends. The primitive societies of which I have been speaking are governed by a body of custom. They are governments by law instead of men, and while demanding the observance of certain taboos which to us often seem absurd, do not interfere beyond them in the private lives of their members. Within those limits the independence of the individual and the family is powerfully and stubbornly maintained. Moreover, and this is a matter to be particularly noted, their main concern is with the internal well-being of the community, not with its external policy.

The modern regimented state, on the other hand, is a government of men rather than laws, and, what is worse, it is a government in which foreign policy is a major interest and the military motive a primary concern. The dictator knows well that there are no motives as strong as fear and hate to induce masses of people to submit to regimentation, for such feelings support armies, and military life calls for just that kind of government. Therefore, a bogey is needed to hold constantly before the minds of the people, and this, though it may be furnished by a capitalist or communist class or party, or a religious group, is most successfully met by a foreign country. Frighten people sufficiently by telling them what outrages such a nation intends to perform upon them, and persuade them that their only hope is in absolute unity and "preparedness," and you have them in a mood to submit to all demands and ready to mob any one whom you designate as sympathetic with the "enemy." When people are thoroughly frightened or angry they lose their self-control and their willingness to exercise it. But of course the stimulus has to be supplied repeatedly in order to keep the desired emotions alive, discordant notes might destroy the effect, and so there must be no opposition press, no dissenting voices. The cult of fear and hatred must be blown up regularly. The least wavering must be labeled as the work of the chosen devil or group of devils. Everything contrary to the dictatorial superstitions is occasioned by "a fiendish conspiracy," and so on. Of course, the wise among the dictators must realize that these constant applications of the shudder complex can not go on indefinitely. The slogans which at first excited fear and wrath begin to grow stale. They are presently repeated mechanically, with the tongue farther and farther into the cheek, become objects first of covert and finally of open jest, and the end of the régime is in sight unless the prejudice-pump can be reprimed with a foreign war. War itself is not desired. Threat of war is useful because it keeps regimentation alive, but war might wreck the entire structure. It is, therefore, only a last resort.

In the meantime, however, the hysteria on which dictatorships thrive has done great damage to civilization. The recurrent image-breaking in which works of art and beautiful buildings have perished, although the fury which occasioned it has in many cases been due to real abuses and sometimes accompanied ethical reform, has made the world poorer none the less. These emotional upheavals have not, of course, always been associated with dictatorships, but dictatorships make willing use of them. The burning and proscription of books with which the party in power happens to disagree, and in which modern dictators are bedfellows with the Chinese emperor who built the Great Wall, with the Caliph Omar and with many religious sectarians, represents another loss. How great would have been our heritage—how much greater than it is—if the good things of one culture had been preserved by the next and only the abuses discarded, instead of having good and bad alike exposed to the destructive outbursts of fanatic frenzy which have periodically disgraced and debased mankind!

While much of this destruction has been wrought by mobs armed with nothing more than sticks and stones and hatred, the greatest losses have been due directly or indirectly to the maintenance of the institution we call war. I have already spoken of war, or rather the threat of war, as the chief weapon in the armory of a dictator. War does not settle, but instead postpones the settlement of, questions which must finally be solved by general consent and sometimes by the working of natural laws. Violence we may always expect, but it is one thing to deal with violence breaking out against the law and quite another to create deliberately war machines which are symbols of violence and therefore weapons for the perpetration of irrational acts. I am not an advocate of passive resistance in the face of aggression, but that does not prevent me from regarding the entire war institution, as such, as a total loss to humanity. It is, I am aware, considered by some an instrument for the advancement of mankind. I shall be prepared to accept that belief when it is shown that cancer has a perfecting influence on the human organism and that fleas evolve the dog.

Great as is the damage done by dictatorships in keeping the war spirit alive for political and personal ends, it is nothing beside the damage from their interference with the individual and family life within their borders. Let us consider the family life for a moment. Normally, human beings desire such a life, but a healthy domestic life is possible only under certain conditions. Those of us who are descended from old colonial houses, in which the number of offspring sometimes ran to ten or twenty to the family, have been wont to imagine those as the good old patriarchal days when each man's "quiver" was full of sons and daughters, and if he did not sit under his own vine and fig tree it was due to climatic rather than economic considerations. But geneticists who have probed into the idyllic homes of our ancestors have found that the extent of unoccupied land and the communal character of the farming life of the period made children an asset, and that to bring many of these families into existence exacted the lives of several mothers. It does not follow that a family life even as limitedly satisfactory as that could be built up in a highly industrialized community. How even the supposed advantage of a numerous family may be abused under somewhat analogous conditions was brought vividly to my attention in one of the more backward parts of our country. There I learned that it was the practice of farm owners to rent land by preference to families with large numbers of children so that there would be more unpaid labor available, and it was intimated that parents increased the numbers of their children with an eye to this tendency. Whatever immediate advantage the farm owner and the parents may have derived from such exploitation of childhood, it could only be damaging to the community as a whole, and probably made problems for society to face at a later day.

If the sexes were precisely even numerically and all individuals married, and all the children grew up to have offspring in their turn, each family must then have one son and one daughter on an average merely to renew the population of the globe. We know, of course, that that condition never has occurred, nor will it ever occur. The wastage of life is such, coupled with voluntary and involuntary celibacy, that families that reproduce might perhaps average from four to six children in order to keep the population normal. If you review in your minds how many families of your acquaintance have from four to six children and how much time and care the proper rearing of children demands—those of you who have had experience with them—you will shed no tears over the cries of distress from so-called overpopulated countries "in need of more territory," especially when it is remembered that those states which wail most bitterly are the ones which subsidize childbirth and put a ban on family limitation. Mass production of infants can be intended only to aggrandize the power of a state and fill the ranks of its armies.

It is doubtful, however, whether such high-pressure methods of creating potential cannon-fodder will succeed. It is rather probable that this will prove another case of the sacrifice of quality to quantity. In spite of the failures of so many families, no device has yet been found for the raising of more efficient children apart from family control and guidance. It is probable that each family has an optimum level for the rearing of offspring, some functioning best with one, some with two and some with several, and some families performing their greatest uses to society without offspring. It is not a question of economic but of psychological and affectional adequacy. If government simply removes the environmental limitations to the proper functioning of a family, well and good, but when it goes beyond that it may overburden efficient parents and bribe inefficient parents to bring children into the world for which they can not care. The natural result of this state of affairs will be adoption of child-rearing by the state itself more and more, a custom also resorted to to protect the rising generation from "political heresy."

In assuming this attitude the state pretends that it has the higher good of its people at heart, but, in destroying the optimum family balance and breaking into the normal family life, it goes far toward destroying family happiness, and for this in the case of the ordinary citizen there can be no substitute, however successful the state as a whole may appear to be. A happy family life can not be harmonized with a life in which the parents are reduced to the status of studs. It is probable, furthermore, that the state will sacrifice in the long run the very advantage which it sought. You can not interfere with the delicate structure of family life and parental affection and raise men and women to be cogs in a machine without endangering their utility for anything else. And the ultimate successes of nations are due, not to the adjustment of parts to a predetermined pattern but to the ability of its citizenry to meet successfully conditions which are unprovided for and unforeseen. A dictatorship which would endure must raise a new dictator, and the history of absolutism shows that no way has yet been found to select a succession of absolute monarchs guaranteed to maintain the level of the founder of the line.

You are all aware of the damage science has suffered in the highly regimented states. Every student in the realm of natural science would be justly indignant if he were told what deductions he must draw from his experiments before he began them, but over great areas of the world workers in the social sciences are, in effect, admonished in just this manner. Scholarship withers wherever and whenever it must subscribe in advance to a political, social or economic superstition. You are brought together here by the pursuit of truth, not to validate *Das Kapital* or *Mein Kampf,* and if you sacrifice the untrammeled pursuit of truth in one line of endeavor for a prescribed conclusion, there is the strongest likelihood that the perversion will spread to other disciplines and contaminate them all. Paradoxically, but not for the first time, only the martyrs will survive.

But fortunately, prejudice is a hothouse plant withered by the first breath of air from the great outdoors of truth. The cosmos is one and the world of mankind at heart is international. Interruption of the free flow of thought and the free flow of trade from nation to nation, mutual enmity, armaments, restrictive tariffs and monopolies damage most in the long run those responsible for them, and sooner or later they are doomed to pass away. In spite of the efforts of political, social or clerical groups to coerce the spirit of man, it has shown in all ages the capacity to resist and to reassert its freedom. To those emotional insanities which have for their object the curtailment of human liberty it has opposed the grander movements of the soul such as the social and ethical uplift which came with Christianity, the great revolutions of the eighteenth century and the emergence of the scientific approach. The morale which carried through those achievements was due to the fact that participants in them had a vision of truth and justice beyond that prevailing in the world about them, and a sense, too, that evolution and the course of history are, or can be made to be, upward processes. This is one reason why I object to that superficial materialism which would give mind a place secondary to matter, and why I refuse to regard the "heat-death" hypothesis as the last word in cosmic theory. The persistent climb of life up the evolutionary ladder, and, in spite of his numerous lapses, of mankind up the cultural ladder lead me to believe that decline is temporary and progress normal.

And now for one ultimate question. We may assume that evolution among the organisms below man was unconscious, but that is not true, not altogether true at least, of cultural advance. Why do we aspire? Why do we scientists pursue truth? Is it for the gratification of our curiosity? Or the mere interest of the quest, like the resolution of a crossword puzzle? Or is it for the material benefit of mankind, ourselves included? While all these play a part, I am inclined to think our feeling comes to be simply that it is good to penetrate more and more deeply beneath the veil of appearances and the veil of prejudice and orient ourselves more and more to the profounder realities.

The conscious attitude of some of you is no doubt essentially humanistic. You are engaged in congenial work in pleasant surroundings and among appreciative associates. Like Thoreau you are willing to waive questions of the hereafter with the thought, "One world at a time." You are willing to trust your immortality in the hands of the scholars who may come after you and let such good work as you do benefit future generations upon this material world without disturbing yourselves as to another. There are some, however, and I am numbered among them, who, while they may be satisfied sufficiently with their own immediate surroundings, are unwilling to contemplate as the entire story the fates which seem to have been allotted undeservedly to many about them. They would like to regard themselves as inhabitants of a cosmos which, after all, and in the final summing up, is just, and, what is another way of saying the same thing, they would like to feel that this enterprise of life upon which we have been embarked without any volition on our part, is a worth-while process. They would like to think of it as something more than an endless procession of life out of and into the dark.

OBITUARY

EDMUND BEECHER WILSON

1856–1939

It is given to few men to exert so great an influence in their chosen field of scientific research and also to attract so many friends over a much wider range of interest. The beauty of Wilson's workmanship and the balanced judgments of his decisions are two of his outstanding accomplishments. In the discussions of the broader aspects of the problems, connected with his researches, his careful consideration of the pros and cons might lead one who did not know him personally to infer that he held no very definite opinions in the wider philosophical fields of speculation. On the contrary, he had very strong predilections, but he had so thoroughly trained himself to control his personal opinions that he kept them well in hand.

Perhaps Wilson's outstanding contribution was in the field of cell-lineage, following the classical studies of Whitman. Work of this kind is extremely laborious, requiring the most meticulous attention to details, but Wilson never lost sight of its broader aspects. He soon became one of the outstanding leaders in cytology, as the study of the cell came to be called. His researches and wide reading of the literature culminated in the final edition of his fine book on "The Cell in Development and Heredity," to the writing of which he devoted more than twenty years. Cytology in his hands covered a broader field than the traditional histology. In fact, it became a search for the factors or causes, starting with the primordial cell—the egg—that are at work during development bringing about the segregation of groups of cells into organs and their subsequent histological and functional specialization.

Later when other methods came into vogue for studying the developmental problems of the egg by cutting the egg into fragments or by separating the blastomeres —a procedure that traces back to Chabry, Roux and Driesch—Wilson with a more thorough background of cell-lineage made outstanding contributions both factual and theoretical. The fundamental problem at stake, which is spoken of in general terms as "the organization" of the egg, is still with us. It has, I think, become more apparent that the many attempts that have been made to interpret the organization of the egg are futile until organic chemistry furnished us with more information as to the properties of proteins, their catalysts and the reconstructive properties of living protoplasm. Nevertheless, the descriptive and experimental work of embryology has made clear the kind of problems involved.

Wilson added greatly to our knowledge of the chromosomes and especially to their behavior during the maturation of the germ-cells. The beauty of fine preparations appealed to his artistic sense. His interest and leadership in this field led to two important discoveries. One of his students, W. S. Sutton, was the first to point out that the manoeuvers of the chromosomes furnish the mechanism for Mendel's two laws of heredity. The other discovery, following an earlier suggestion of McClung, was made independently by Miss N. M. Stevens of Bryn Mawr and Wilson of Columbia, namely, the rôle of the sex-chromosomes or the X-chromosomes, as Wilson called them, in the determination of sex. These discoveries prepared the way for the interpretation of sex-linked inheritance that has played an important rôle in modern genetics.

Wilson's death will be felt deeply by his many friends and admirers. His scientific career was well rounded out and was, in a sense, complete. Few men have accomplished as much, and one may well envy him the great joy he had in carrying on his work and the enthusiasm that he imparted to a host of colleagues, students and friends.

THOMAS HUNT MORGAN
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SAMUEL STEEN MAXWELL

SAMUEL STEEN MAXWELL was born of Scotch-Irish parentage at Manor-cunningham, County Donegal, Ireland, on August 4, 1860. He died in Berkeley, California, on January 28, 1939.

Dr. Maxwell's ancestry has been traced to Max, son of Unwin, who settled near the Tweed in Scotland about 1160. His immediate family settled in the midwest of the United States when he was still a young boy.

After taking a B.S. degree at Amity College, Iowa, in 1886, he remained another three years at his alma mater, instructing first in mathematics, later in natural science and in the meantime working for an M.S., which was awarded him in 1888. Summers were devoted to instruction in the Iowa Teachers' Institutes. He married Lula Beatrice Taylor, of Lovelace, Kentucky, on June 30, 1887. His widow and three of his four children survive him.

A year of graduate work at the Johns Hopkins in 1889–90 was followed by a professorship in biology at Monmouth College, Illinois. Here he remained for the next twelve years, except for an interval of two years spent in graduate work under Jacques Loeb at the University of Chicago, where he obtained his Ph.D. in 1896. His thesis on the physiology of the annelid brain was published in *Pflüger's Archiv*. For two years Monmouth College was without a president, and during this period Dr. Maxwell served on the board of administration, and at the same time he edited the college magazine.

In 1902 he left the Midwest on a fellowship in physiology at the Harvard Medical School and remained on for two years as instructor. In 1902, Loeb left Chicago for the far West to head the division of physiology at the University of California. The rooms assigned to him in the old East Hall were inadequate for the school of experimental physiology which Loeb wished to establish, but when the Spreckels Physiological Laboratory was built on a knoll overlooking the beautiful Faculty Glade, it was equipped with special aquaria for experimentation on marine invertebrates, and there was space enough for mammalian experiments and biochemistry as well. Dr. Martin Fischer, one of Loeb's pupils, had gone with him from Chicago to serve as instructor, and when Fischer accepted the professorship of pathology at the Oakland College of Medicine and Surgery in 1905, Dr. Maxwell was brought from Harvard to take his place.

Dr. Maxwell remained at the University of California for the rest of his life, rising gradually through the various ranks from instructor to professor. When Loeb went to the Rockefeller Institute in 1910, biochemistry was split off from physiology and Dr. Maxwell was made chairman of the division of physiology. Except for an interval of four years, he continued to hold this position until his retirement.

At the time of Dr. Maxwell's arrival in California the activity in Loeb's laboratory was intense. The subject upon which all the workers were concentrating their attention was temperature coefficients of physiological reactions. Martin Fischer had investigated the effect of heat on the beat of the crab's heart, and Dr. Theodore Burnett, at that time a volunteer in the laboratory, was assisting Loeb in similar experiments on the rate of conduction of the nerve impulse in the huge garden slugs found on the campus. For this purpose Loeb had had an expert machinist construct an elaborate piece of apparatus of shining polished brass and ebonite, which, unfortunately, proved useless. Loeb in disgust turned the problem over to Dr. Maxwell as soon as he arrived. Dr. Maxwell merely soldered a few wires to a discarded candy tin, and solved the problem in short order. This was typical of Dr. Maxwell's experimental methods. Simple, home-made gadgets to supplement the ordinary physiological apparatus in his hands brought results.

Dr. Maxwell's early papers were along lines similar to Loeb's, *e.g.*, the effect of salts on ciliary activity, chemical stimulants of the cerebral hemispheres, etc. He wrote a popular article on Loeb's experiments in chemical fertilization, and with Loeb wrote on heliotropism in plants and animals.

It was, however, not until 1919 that he began the work on the labyrinth with which his name is always associated. Loeb founded the *Journal of General Physiology* in 1918, and in the second volume appeared two articles by Dr. Maxwell, (1) "Comparison of the Otolith Organs and of the Semicircular Canals" (2) "The Mechanism of the Dynamic Functions of the Labyrinth." This was the beginning of a series of papers which in 1923 were summed up in his book "Labyrinth and Equilibrium" in the series of monographs on experimental biology sponsored by Loeb, Morgan and Osterhout. This was the first, and for some time, the only volume on vestibular function in English. The conclusions drawn were based almost entirely on experiments on the dogfish, but by inference they have been considered to apply to mammals and have been incorporated in many texts of physiology for medical students. Until 1930, when Creed translated Canus's "The Physiology of the Vestibular Apparatus," Dr. Maxwell's book was the authority on this subject.

Shortly after his retirement Dr. Maxwell suffered partial paralysis which affected both speech and muscular movements. However, he made fairly good recovery and for several years was able to go about with the use of a cane, and his speech, although slow, had suffered no other impairment. Death was caused by a second stroke.

Dr. Maxwell's name will always be associated with that of Loeb in the scientific work which came out of the Spreckels Physiological Laboratory of the University of California during the early years of this century and for his careful experiments on the inner ear of the dogfish.

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Berkeley

RECENT DEATHS

Dr. Arthur Edward Hill, professor of chemistry in the College of Arts and Pure Sciences of New York University and head of the department of chemistry, died on March 16 at the age of fifty-eight years.

Dr. Irving Gilman Davis, professor of agricultural economics and chairman of the department of economics of Connecticut State College, died on March 15 at the age of fifty-four years.

Dr. Frank Parsons Norbury, since 1913 superintendent of the Norbury Sanatorium at Springfield, Ill., died on March 15 at the age of seventy-five years.

Dr. Leonard Halford Dudley Buxton, since 1928 reader in physiological anthropology at the University of Oxford, fellow and bursar of Exeter College, died on March 6. He was forty-nine years old.

SCIENTIFIC EVENTS

THE IMPERIAL BUREAU OF DAIRY SCIENCE

In 1936 the British Commonwealth Scientific Conference, which met in London to consider the working of the organizations controlled by the Executive Council of the Imperial Agricultural Bureaux, recommended that a new Imperial Bureau of Dairy Science be established. The conference also suggested the National Institute for Research in Dairying as the most suitable location for the bureau.

Following agreement by all the authorities concerned the new Imperial Bureau of Dairy Science has now been established at Shinfield, near Reading. Professor H. D. Kay, director of the National Institute for Research in Dairying, has been appointed director of the bureau. W. G. Sutton, Massey Agricultural College, New Zealand, has been appointed deputy director and has now taken up his duties. The bureau is financed cooperatively by the governments of the British Empire in the same way as the other Imperial Agricultural Bureaux.

The functions of the bureau are to index research work in dairy science, whether carried out in the Empire or elsewhere; to collect, abstract and collate information bearing on dairy science and to distribute such information both by publication and by private communication to research workers, officials and advisory officers throughout the Empire. In addition the bureau is charged with the duty of establishing and maintaining contact between research workers with common interests, promoting conferences of workers and visits to research centers, and in general encouraging the circulation of information ideas, material and personnel.

The field of dairy science to be covered by the bureau was defined by the conference when recommending its establishment. This field includes the microbiology, chemistry and physics of milk and its products; animal diseases in so far as they affect milk and its products; the technology of processing milk and manufacturing dairy products; the physiology of milk secretion as affecting quality and quantity of milk and dairy products; standards for the composition and quality of milk and its products.

The routine work of the bureau, such as indexing and abstracting, will already be familiar to many dairy workers from the activities of the bureaus already established in other subjects. An aspect of bureau work which may not be so well known and understood is the more informal service which can be given to research workers, teachers and field officers. The bureau aims to be the friend of these dairy workers. It will deal directly with the individual workers in dairy science, who are invited to write to the bureau for information which is not obtainable in their own countries. It may be able to supply the information or to put the inquirer in touch with some one who can do so more effectively.

SCHOLARSHIPS OF THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY AT THE CARNEGIE INSTITUTE OF TECHNOLOGY

THE cooperative engineering educational plan of the Carnegie Institute of Technology, in cooperation with the Westinghouse Electric and Manufacturing Company, which enables a student to obtain practical experience in Westinghouse plants during five summer vacations and two college semesters as well as to complete eight semesters of college class work, was made possible by the appropriation of $200,000 by the Westinghouse Company in 1937. Last summer the first ten scholarship students were elected.

When in complete operation, the scholarship course will include fifty students, with ten scholarships becoming vacant each summer. A scholarship has a value of $3,000 and is awarded to a student of exceptional ability, final selection being based on results of competitive examinations, character and personality. Applications for the second scholarship class must be received before April 1.

D. F. Miner, George Westinghouse professor of engineering at the institute, who as coordinator of the cooperative program supervises the scholarship holders, points out that the plan affords an unusual opportunity for combining theoretical training with practical experience. At the age of twenty-two to twenty-four, the participants will have completed a four-year formal engineering course and, at the same time, will have acquired a substantial background of two years' industrial experience.

W. G. Marshall, vice-president of the Westinghouse Company, states that through this opportunity in engineering education the Westinghouse Company "confidently expects to guide the development of a group of young men who will become industrial engineering and business leaders of the future. The first year of operation of the plan has met with wide success, and it is anticipated that even greater accomplishments by the students will be evidenced during the coming year."

Last year the scholarships were awarded to the ten highest ranking students among 293 applicants. The successful students came from states as widely separated as Montana, Pennsylvania, Washington, Ohio and New Jersey.

GRANTS OF THE COMMONWEALTH FUND IN AID OF MEDICAL RESEARCH

THE twentieth annual report of the Commonwealth Fund states that in trying to advance public health the fund has found no better way than "to help schools to teach and doctors to learn the best contemporary medicine." Appropriations for this purpose through various channels reached the sum of approximately $375,000 in 1938. As a new element in this program, the ten fellowships were awarded to junior instructors in medical schools, on nomination of their department chiefs, not only to give promising young men an opportunity for professional growth but to strengthen the teaching resources of the schools where they are at work. This offer, it was announced, will be continued. Similar fellowships were given to four junior staff men interested in the teaching of pediatrics to enable them to study psychiatry as an aid to the better handling of children.

Other new awards of the year included subsidies to the departments of preventive medicine at New York University and the Long Island College of Medicine. At each of these schools fourth-year students will work in district health centers of the New York City Health Department. Grants to Tulane, Vanderbilt and Tufts, also for the teaching of preventive medicine, were continued from previous years, together with a subsidy to the department of psychiatry at the University of Louisville. The fund assisted in the post-graduate teaching of medicine at Harvard, Vanderbilt, Tulane and the University of Minnesota, and offered fellowships to men in country practice in seven states.

Funds amounting to more than $345,000 were set aside for medical research at fifteen different medical schools and hospitals. Judging each appeal on its merits, the fund has nevertheless concentrated its subsidies to some extent in groups of related studies at different centers. Thus in the field of heart and kidney disease it reported grants to the University of Pennsylvania for the study of kidney function, to the Johns Hopkins for the study of essential hypertension, to Western Reserve University for work on chronic nephritis and the causes of heart failure, and to Yale for a general investigation of the causes of circulatory disease. A study of arthritis at the Massachusetts General Hospital, Boston, and three studies of rheumatic fever were aided, together with three on problems of growth and development in childhood. New appropriations in the field of the acute communicable diseases included two to the University of Pennsylvania for the study of air-borne infections and the chemical structure of the streptococcus.

GRANTS OF THE GEOLOGICAL SOCIETY OF AMERICA

The Geological Society of America announces that the following grants in support of special research problems have been authorized by the council:

W. H. Twenhofel, Madison, Wis., $1,440. Professor Twenhofel will return to Newfoundland this coming field season. With an assistant he will extend studies begun in 1935 along the coast and islands of Notre Dame Bay and along the Exploits River, and continued in 1936 in the White Bay region. Plans for the new work call for examination of the interior, the more inaccessible parts of which will be reached by airplane. Professor Twenhofel has been assured of the active cooperation of Dr. A. K. Snelgrove, government geologist of Newfoundland. The studies will include not only the stratigraphy but the physiography and glacial geology as well.

R. Dana Russell, Baton Rouge, La., $1,800. Professor Russell will study sediments off the mouth of the Mississippi River in the Gulf of Mexico. The Bureau of Fisheries will cooperate by furnishing the use of the ship *Pelican*, and the Geological Society is financing the construction of 2 Piggot "Guns," the original of which was developed in 1935 with the aid of a grant from the society. Dr. C. S. Piggot, of the Geophysical Laboratory, will join the expedition.

V. Tanner, Helsingfors, Finland, $2,500. Dr. Tanner has for a quarter of a century been studying the late Quaternary changes in level in Fennoscandia and related areas in Europe. In the summer of 1937 he visited Newfoundland and Labrador and became convinced of the possibility of correlating changes of level in Labrador with those in Fennoscandia through a detailed study of raised beaches and other phenomena. The grant from the Geological Society will enable him to extend his investigations to the coast of Labrador.

Randolph W. Chapman, Huntington, W. Va., $540. Dr. Chapman and his brother, Dr. Carleton A. Chapman, of the University of Illinois, will make a detailed petrographic and structural study of Mt. Starr King and the surrounding region in northern New Hampshire. The two Chapmans have taken an active part in the detailed mapping and study of the geology of New Hampshire conducted during recent years under the supervision of Professor Marland Billings. The White Mountain magma series, the question of cauldron subsidence, laccolithic intrusions and the Ammonoosuc thrust fault will be investigated.

Chester Stock, Los Angeles, Calif., $1,800. With the assistance of Dr. L. R. David, Dr. Stock will conduct a study of Tertiary fossil fish faunas of the Pacific Coast, involving taxonomy, comparison of morphological characters, distribution on the Pacific Coast of North America and the significance of fossil fishes in related geological problems, such as correlation of marine sediments and conditions of sedimentation in the area involved.

W. H. Newhouse, Cambridge, Mass., $1,160. Professor Newhouse will devote the coming summer to field studies of selected mineral deposits with view to following out evidence already in hand that the direction of flow of the ore-bearing solutions can be determined from mineral symmetry. Whether the deposit is a filled vein or a replacement body, the criteria already developed appear to be useful in solving problems in ore deposition.

Robert T. Hill, Dallas, Texas, $1,800. Dr. Hill's studies cover the history of geologic investigation in the Southwest, including identification and interpretation of the routes of Cabeza de Vaca and Coronado. A volume is expected to result from these studies.

Roger Revelle, La Jolla, Calif., $900. Dr. Revelle, of the Scripps Institution of Oceanography, will continue his studies of recent marine sediments from various localities between Panama and Alaska that have been sampled by the Institution, by the U. S. Coast and Geodetic Survey and by the Navy. Many of the samples consist of cores taken with the Varney-Redwine coring instrument recently developed at the Scripps Institution. The mechanical analyses of sediments that pass a 230-mesh screen are to be made from a sodium carbonate suspension by taking pipette samples at intervals of time corresponding to the Wentworth size grades down to 0.5 microns in equivalent particle diameter. The results will give the particle size distribution and organic content, the relationship between size distribution and topography, and changes in environmental conditions occurring during relatively recent geologic time. The coarser separates will be preserved for petrographic and micropaleontologic studies.

A. K. Miller, Iowa City, Iowa, $600. Arrangements have been made for Dr. Miller to complete the studies long in progress by Dr. E. O. Ulrich and the late Dr. Aug. F. Foerste of Ozarkian and Canadian cephalopods, and to complete the manuscript for publication. Dr. Miller will be assisted in the work by Dr. W. M. Furnish.

THE PACIFIC DIVISION OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE twenty-third annual meeting of the Pacific Division of the American Association for the Advancement of Science will be held this year at Stanford University from June 26 to July 1. The general sessions will be held on Tuesday, June 27, and will begin with a symposium on "Radiation and Life." The speakers will be Dr. W. V. Houston, of the California Institute of Technology; Dr. John H. Lawrence, of the University of California; Dr. M. Delbruck, also of the California Institute of Technology, and Professor Robert R. Newell, of Stanford University Medical School. A session on reviews of current research will be held in the afternoon. Professor J. W. McBain, of Stanford University, will speak on "Recent Advances in Colloid Chemistry," and an address by Dr. A. R. Davis, of the University of California, will follow. Professor Henry Borsook, of the California Institute of Technology, will contribute a discussion of "Biological Oxidations and Reductions," and Dr. J. W. Macfarlane, of the University of California, will discuss "Research on Personality Development." A general reception for members and guests of the division and its associated societies will follow the meeting. Among the evening addresses will be that of the president of the Pacific Division, Professor S. J. Holmes, of the University of California, on "Darwinian Ethics and Its Practical Applications." Professor John Desmond Bernal, professor of physics at Birkbeck College, the University of London, will also deliver one of the evening addresses.

Seventeen scientific organizations on the Pacific Coast are participating actively in the meeting by holding scheduled sessions throughout the week, while members of associated societies not formally participating are invited to take part by attending or presenting papers at the scheduled sessions. Titles of papers may be sent to the office of the Secretary, Pacific Division, American Association for the Advancement of Science, Stanford University, up to May 3, or, if sent to the secretaries of affiliated societies, the closing date for their inclusion in the program is April 29.

The meeting of the Pacific Division will be followed by a symposium commemorating the enunciation of the cell theory (July 1 to 5), and by the sixteenth National Colloid Symposium (July 6 to 8). Both will be held at Stanford University.

SCIENTIFIC NOTES AND NEWS

AT the annual meeting in Philadelphia of the American Association of Physical Anthropologists a dinner will be given on April 4 at the Hotel Pennsylvania in honor of the seventieth birthday of Dr. Aleš Hrdlička, curator of the Bureau of Anthropology of the U. S. National Museum. Dr. Hrdlička was born in Bohemia on March 29, 1869.

ACCORDING to a cablegram from England, Dr. C. E. Kenneth Mees, director of the research laboratories and vice-president of the Eastman Kodak Company, was nominated on March 16 for fellowship in the Royal Society, London.

THE International Acetylene Association recently awarded the James Turner Morehead Medal to John J. Crowe, research engineer of the Air Reduction Sales Company, New York. The medal was presented at the convention of the association, which met at Houston, Texas, from March 8 to 10. It was awarded to Mr. Crowe "in honor of his unceasing and successful technical activities," particularly in the development of apparatus for oxyacetylene welding and cutting.

DR. ADOLF WINDAUS, professor of chemistry at Göttingen, has been awarded the Pasteur Medal of the Society of Biological Chemistry at Paris.

THE Mary Kingsley Medal of the Liverpool School of Tropical Medicine has been awarded to Dr. Werner Schulemann, professor of pharmacology at the University of Bonn.

IT is announced in *Nature* that G. Ingle Finch, professor of applied physical chemistry at the Imperial College of Science and Technology, London, was presented at the Belgian Embassy on January 23 with the order of Commander of the Order of King Leopold II, which was conferred on him by King Leopold III for services rendered to science in Belgium during his term of office as Fondation Francqui professor in the University of Brussels during 1937–1938. Dr. Otto Loewi, professor of pharmacology at the University of Graz, was recently appointed his successor.

DR. ALFRED VOGT, professor of ophthalmology at the University of Zurich, has received the Cothenius Medal of the Academy of Natural Sciences at Halle.

The hundredth anniversary of the birth of Ludwig Mond, the distinguished English industrial chemist, occurred on March 7.

Dr. S. W. Ranson, director of the Institute of Neurology of the Medical School of Northwestern University, has been elected a corresponding member of the Society of Neurology of Paris.

The retirement is announced of Dr. Albert H. Wilson, professor of mathematics at Haverford College, who has been a member of the faculty for twenty-nine years.

Professor F. J. Cole retired in September from the chair of zoology at the University of Reading, which he had held for thirty-two years.

Dr. Erwin Finlay Freundlich, formerly professor in the German University at Prague, has been appointed Napier lecturer in astronomy and director of the new Astronomical Observatory in the United College of St. Andrews.

Dr. Carl Wilhelm Correns, of Rostock, has been appointed professor of mineralogy and geology at Göttingen.

Dr. Frederick C. Leonard, chairman of the department of astronomy of the University of California at Los Angeles, will be visiting professor of astronomy in the summer session of the University of British Columbia, Vancouver, which will be in session from July 3 to August 18, and Dr. Daniel Buchanan, dean of the Faculty of Arts and Science and head of the department of mathematics of the University of British Columbia, will be visiting professor of astronomy and mathematics in the summer session at Los Angeles, from June 26 to August 4. A similar exchange was made in the summer of 1937.

Deputy Commissioner Charles E. Jackson has been appointed Acting Commissioner of Fisheries to discharge the duties of the Commissioner of Fisheries until such time as an appointment is made to fill that position. The resignation of Commissioner Frank T. Bell was accepted by the President on January 7.

Dr. G. E. Hilbert, senior chemist in the Bureau of Chemistry and Soils of the U. S. Department of Agriculture, has been appointed scientific adviser, with headquarters at Washington, D. C., in the general organization of the Regional Research Laboratories, which are being established by the department.

Dr. C. K. Leith, professor of geology at the University of Wisconsin, has been reappointed by Secretary Hopkins a member of the Business Advisory Council to the U. S. Department of Commerce. Professor Leith is also chairman of the Minerals Advisory Committee to the U. S. War and Navy Departments, acting through the Army and Navy Munitions Board.

Dr. Wendell S. Niederhauser, assistant professor of chemistry at Williams College, has resigned to take a position as research chemist with the Rohm and Haas Company, of Philadelphia.

The Jacob Wertheim Fellowship for the Betterment of Industrial Relations has been awarded by Harvard University to Anthony Luchek, of the University of Michigan, to enable him to complete a study of labor conditions in the automobile industry. The fellowship, with an endowment of $100,000, was established in 1923.

The Commonwealth Fund has granted the sum of $8,360 to the Institute of Pathology at Western Reserve University to be expended over the course of a year in support of the studies on the chemistry of immunity of Dr. E. E. Ecker, associate professor of immunology and immunologist to the University Hospital. Provided progress is made, a similar appropriation will be made for an additional two years.

The Rockefeller Foundation has made a grant of $2,000 to continue for the year 1939 the studies in malaria conducted by William H. Taliaferro, chairman of the department of bacteriology and parasitology and dean of the Division of the Biological Sciences of the University of Chicago.

The National Committee for Mental Hygiene will give an additional grant of $1,000 to aid in the research in dementia praecox being carried on by Drs. Esther Bogen Tietz and Douglas Goldman, at Longview Hospital, Cincinnati.

Dr. John A. Lanford, assistant professor of surgical pathology at Tulane University, has been elected a member of the board of directors of the American Society for the Control of Cancer.

Dr. Dugald C. Jackson, professor emeritus of electrical engineering at the Massachusetts Institute of Technology, lectured on March 15 at the Franklin Institute, Philadelphia. The title of the lecture was "Man in an Engineering World." At this meeting presentation of the Boyden Premium was made by the institute to Dr. John S. Hall, of the Amherst College Observatory.

Dr. Henry B. Ward, of the University of Illinois, gave an illustrated lecture on March 8 at the Illinois State Museum on "Salmon Psychology and its Relation to Conservation." The lecture was one of the winter series sponsored by the museum.

Dr. Enrico Fermi, professor of physics at Columbia University, gave an illustrated lecture on "The Mesotron" at a joint meeting on March 16 of the Washington Academy of Sciences and the Philosophical Society of Washington.

THE Edward K. Dunham Lectures for the promotion of the medical sciences were given on March 8 and 10 at Harvard Medical School by Dr. K. Linderstrøm-Lang, of the Carlsberg Laboratory, Copenhagen. The titles of the separate lectures were: "Micromethods for the Determination of Enzymes," "Distribution of Enzymes in Cells and Tissues" and "Proteins and Proteolytic Enzymes." He lectured on March 21 at the Franklin Institute under the auspices of the Biochemical Research Foundation on "The Histo-chemistry of Cells."

DR. THOMAS M. RIVERS, director of the Hospital of the Rockefeller Institute for Medical Research, will deliver five Lane lectures at the School of Medicine of Stanford University during the week beginning on May 22. The subjects of the lectures will be: "Lymphocytic Choriomeningitis," "Pathology of Virus Diseases," "Immunological and Serological Phenomena of Virus Diseases," "The Nature of Viruses" and "The Treatment and Prevention of Virus Diseases."

THE fourth annual science forum lecture at Mundelein College, Chicago, will be given on April 18 by the Reverend Alphonse M. Schwitalla, S.J., dean of the Medical School of St. Louis University. His subject will be "Schwann and a Century of Scientific Progress." The lecture will commemorate the one hundredth anniversary of the publication of the cell theory.

DR. HOWARD C. NAFFZIGER, head of the division of surgery of the Medical School of the University of California and president of the American College of Surgeons, has been invited to make an address on the occasion of the celebration on May 4 of the anniversary of the founding of the Medical School of the Johns Hopkins University.

DR. FRANCIS G. BENEDICT, formerly director of the Nutrition Laboratory of the Carnegie Institution of Washington at Boston, lectured at Notre Dame University, Indiana, on March 13 and 14. The first was an illustrated lecture on animal metabolism, "From the Mouse to the Elephant." The second was entitled "Science and the Art of Deception."

THE regular spring meeting of the Pennsylvania Academy of Science will be held on April 7 and 8 at the Pennsylvania State College, Pa. Information concerning the meeting can be obtained from the secretary, Dr. V. Earl Light, Lebanon Valley College, Annville, Pa.

THE fourteenth scientific sessions of the American Heart Association will be held on May 12 and 13 at the Hotel Jefferson, St. Louis, Mo. The general cardiac program will be given on Friday, May 12, and the program of the Section for the Study of the Peripheral Circulation on Saturday, May 13.

THE tenth spring meeting of the Eastern Psychological Association will be held at Bryn Mawr College on March 31 and April 1, under the presidency of Dr. Karl M. Dallenbach, of Cornell University.

THE American Institute of Nutrition will meet in Toronto on April 26. The morning and afternoon sessions will be devoted to the presentation of papers on current nutrition research. The evening will be given over to a symposium entitled "The Fortification of Foods with Vitamins and Minerals," Dr. E. V. McCollum, professor of biochemistry and head of the department of school hygiene and public health of the Johns Hopkins University, presiding. The program follows: "Basic Nutrition Principles Involved in the Fortification of Foods," Agnes Fay Morgan; "Fortification of Foods in a General Program for Better Nutrition," Lydia Roberts; "Public Health Aspects of Fortification of Foods," W. H. Sebrell; "Governmental Control Problems in the Fortification of Foods," E. M. Nelson, and "Viewpoints of the Food Industries Regarding Fortification," Alonzo Taylor.

DURING the current academic year the department of geology of Bryn Mawr College has conducted a symposium on the problems of the crystalline rocks of the Piedmont Province of the eastern United States. Lectures and field excursions for a selected group of graduate students have been conducted by Professors E. H. Watson and Dorothy Wyckoff. During January and February a series of lectures by workers in this field has been given. The lecturers and their subjects were: G. W. Stose, U. S. Geological Survey, "The Geology and Structure of the Reading Hills, Pa."; Dr. Anna Jonas Stose, U. S. Geological Survey, "The Geology and Structure of the Western Piedmont of Maryland"; Dr. Anna Hietanen, University of Helsinki, Finland, "Orientation of Quartz and Mica in the Wissahickon Schist of the Philadelphia Region"; Dr. Ernst Cloos, the Johns Hopkins University, "Recent Work on the Geology and Structure of the McCalls Ferry-Quarryville Quadrangles"; Dr. Marland P. Billings, of Harvard University, "Metamorphism in Western New Hampshire and Eastern Vermont"; Dr. Robert Balk, Mount Holyoke College, "Problems of Metamorphism in Southeastern New York"; Dr. Eleanora Bliss Knopf, Yale University, "The Role of Mineralogic and Tectonic Facies in Metamorphism."

THE Eastern Regional meeting of the Pennsylvania Junior Academy of Science was held on February 24 under the auspices of the Steinmetz Scientific Society of the Upper Darby Senior High School. Over a hundred and fifty high-school students of science were in attendance, with fifteen science clubs represented. Eleven student papers were presented. There was an attendance of a hundred and ten at the dinner in the evening, at which Dr. Richard M. Sutton, of Haverford College, was the speaker. The Western Regional meeting was held on March 4, under the auspices of the Biology Club of Peabody High School, Pittsburgh, Pa. Thirteen clubs were represented by two hundred and twenty-five boys and girls. The attendance at the dinner was a hundred and forty. Dr. L. K. Darbaker, of the University of Pittsburgh, president of the Pennsylvania Academy of Science, and Dr. Karl F. Oerlein, Teachers College, California, Pa., general chairman of the Pennsylvania Junior Academy of Science, spoke at the morning session. Fourteen student papers were presented.

YALE UNIVERSITY has received from the Rockefeller Foundation a grant-in-aid of $189,000 toward the continued support of the Yale Laboratories of Primate Biology for the five-year period July 1, 1939, to June 30, 1944, and also the sum of $35,000 for the construction of an additional laboratory building at the Anthropoid Station at Orange Park, Florida. Under the reorganization of the laboratories, following the ten-year period for which the project was originally financed, the director, Dr. Robert M. Yerkes, will be responsible to an administrative committee, serving as a board of control. The following have been appointed members of this committee: Drs. Carl G. Hartman, research associate in embryology, Carnegie Institution, the Johns Hopkins School of Medicine, *chairman;* Edgar Allen, professor of anatomy, Yale School of Medicine; Leonard Carmichael, president of Tufts College; William H. Taliaferro, dean of the Division of Biological Sciences, University of Chicago; Robert M. Yerkes, professor of psychobiology, Yale School of Medicine, *secretary,* and, as member *ex-officio,* Stanhope Bayne-Jones, dean of the Yale School of Medicine.

CANDIDATES for the Jacksonian professorship of natural philosophy at the University of Cambridge, which is vacant owing to the resignation of Professor E. V. Appleton, of St. John's College, to accept the secretaryship of the Scientific and Industrial Research Council, should communicate with the vice-chancellor of the university before April 11. The professorship is assigned to experimental atomic physics and will be associated with the Cavendish Laboratory.

IT is stated in *Nature* that a large plaster-of-Paris model of the main new buildings of the Academy of Sciences of the U.S.S.R. is now on view at the Academy's premises in Bolshaya Kuluzhskaya Ulitsa in Moscow. The buildings were designed by A. V. Shchusev. The site for the buildings most favored is on the Frunze Embankment of the Moscow River. The new buildings of the academy, according to the plans, consist of five blocks with a volume of 880,000 cubic meters. In the center of the architectural ensemble is the main block for the presidium of the academy. The hall is large enough to seat 2,000 persons. There are also four smaller auditoriums. Near the main hall are rooms for the demonstration of films and for broadcasting; also a post and telegraphic office and an information bureau. A block has been set aside for the library and storage premises for fifteen million volumes. On either side of the block for the presidium are buildings to accommodate two museums, one of which will be the Natural History Museum.

DISCUSSION

NUCLEAR AND CYTOPLASMIC EFFECTS OF ULTRA-VIOLET LIGHT

THE bactericidal and photolethal effects of ultraviolet light have been known for a long time,[1] but the mode of action of the radiations is still obscure, although many interesting clues have been uncovered. Among the most interesting is the fact that the reciprocal of the curve of bactericidal action at different wave-lengths is suggestive of the absorption curve of the nucleoproteins, a fact which led Gates[2] to propose that the seat of action of ultra-violet light may be in the nucleoproteins of the cell.

If the lethal effect of ultra-violet light is indeed correlated chiefly with the effects upon nuclear constituents, then one might suppose that the isolated nucleus should be far more sensitive to the radiations than a nucleus surrounded by cytoplasm. Sperm are almost naked nuclei; they should serve as convenient material for just such a test. Therefore in one series of experiments the sperm of the sea urchin *Strongylocentrotus purpuratus* were irradiated, then used to inseminate unirradiated eggs; in another series of experiments the eggs were irradiated 30 minutes after insemination. In both cases, following the smaller dosages, division was retarded; following larger dosages, it was irregular; and if the dosage was large enough, abnormal. The results will be reported in detail later. In these studies known intensities of 2654A, a wave-length near the region of maximal absorption by the nucleoproteins[3] was used; the apparatus was essentially like that previously described.[4]

The point of greatest interest in these data, however, is the fact that the amount of energy required to produce a given amount of retardation when the sperm was irradiated then used to inseminate an unirradiated egg was quite different from that required when the egg itself was irradiated. Thus in typical experiments a dosage of 50 ergs per mm^2 of incident energy given the sperm produced pronounced retardation, the first three divisions of the eggs inseminated with such sperm occurring two hours after the controls. A dosage of only 100 ergs given the sperm causes a delay of about 3 hours. A dosage as low as 300 ergs, given the sperm, causes irregular and abnormal development of the eggs inseminated with such sperm. On the other hand, a dosage of 50 ergs per mm^2 given the eggs caused only barely perceptible delay in division and a dosage of 816 ergs per mm^2 caused a retardation of the first three divisions of only about 1½ hours. The eggs will tolerate even 3,000 ergs per mm^2, cleaving slowly to form embryos.

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[1] Duggar, "Biological Effects of Radiation," Vol. II, Ch. 36, 1936.

[2] Gates, SCIENCE, 68: 479, 1928.

[3] Heyroth and Loofbourow, *Bull. Basic Science Res.*, 5: 13, 1933.

[4] Giese and Leighton, *Jour. Gen. Physiol.*, 5: 535, 1935.

These results indicate clearly the greater susceptibility of the sperm and therefore of naked nuclei to ultra-violet radiations. The nuclear material is present in the egg, but the radiations must pass through a thick layer of cytoplasm before reaching the nucleus. The greater resistance of the egg may be dependent upon the protection afforded by the cytoplasm to the nucleus. The radiations are unquestionably destructive to the cytoplasm[5] as well, but cytoplasmic injury is apparently less effective in retarding cell division than is injury to the sperm nucleus.

A. C. GIESE

STANFORD UNIVERSITY

A SPECIES OF AZOTOBACTER TOLERANT TO HIGH ACIDITY

ONE of the prominent characteristics of the aerobic, nonsymbiotic nitrogen-fixing bacteria, known as Azotobacter, is their sensitiveness to acid reactions. There is quite general agreement that pH 5.8 to 6.0 is the acid limit for growth in the absence of fixed nitrogen.[1] As stated by Burk and associates,[2] "The limit of fixation at pH 6.0 has been universally observed by all investigators." Even though Azotobacter has occasionally been recovered from mineral soils as acid as pH 4.5 and was reported as having been found in peat of pH 3.6,[3] there is no evidence that any of the isolated species of Azotobacter are able to develop upon nitrogen-free media which are more acid than the above-mentioned limit. Burk and associates[2,4] reported that the respiratory mechanism of Azotobacter is irreversibly destroyed by prolonged exposure to reactions below pH 5.0.

It is therefore of interest that there is a species of Azotobacter which grows and fixes nitrogen in very acid media. This organism was isolated from acid soils (pH 4.9 to 5.2) of India by P. K. De and has been cultivated in laboratory media for several years.[5] It develops well in nitrogen-free liquid media and upon agar slants from the acid limit which appears to be close to pH 3.0 up to at least pH 9.0. The organism develops well in nitrogen-free media similar to those commonly used for the well-known species of Azotobacter. Sucrose and glucose are readily utilized. During incubation for several weeks in a medium with an initial pH 3.1 and containing 1.5 gm of glucose, 9 mgm of nitrogen were fixed. Where the initial pH was 3.0, 3 mgm of nitrogen were fixed. Nitrogen fixation was greater between pH 3.8 and 8.0.

The acidity of the medium increases somewhat during development of the organism; the change in pH is greater in the alkaline and neutral media than in media which are close to the limiting acid reaction. During growth in media containing nitrate nitrogen the pH rises slightly, whereas in the presence of ammoniacal nitrogen the pH dropped from pH 6.5 to 3.5; this can be ascribed to the assimilation of the ammonium and nitrate nitrogen.

The unusual tolerance of the new organism to extreme acidity clearly distinguishes it from any of the previously described species of Azotobacter and indeed from practically all known bacteria. It appears to be at least as acid-tolerant as the anaerobic, nitrogen-fixing bacteria.[6] In fact, there are only exceptional species of bacteria which are able to develop at more acid reactions. Whether or not the acid-tolerant Azotobacter is widely distributed in soils or will develop in soils over as wide a range of reaction as in artificial media remains to be ascertained.

ROBERT L. STARKEY

NEW JERSEY AGRICULTURAL EXPERIMENT STATION

HIPPOBOSCID FLIES FROM NORTH AMERICAN DOVES

G. R. COATNEY'S note in SCIENCE for September 16, 1938, on the possible carrier of dove Haemoproteus, may be supplemented with the following information.

Microlynchia pusilla (Speiser) is probably the most widely spread hippoboscid fly of doves. It is a strictly

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[5] Giese, *Biol. Bull.*, 75: 238, 1938.

[1] S. A. Waksman, "Principles of Soil Microbiology," 2nd ed. Williams and Wilkins Company, Baltimore, 1932. P. L. Gainey, Proc. and Papers of First Int. Congr. of Soil Sci., Washington, D. C. 3: 107–117, 1928.

[2] D. Burk, H. Lineweaver and C. K. Horner, *Jour. Bact.*, 27: 325–340, 1934.

[3] J. K. Wilson and B. D. Wilson, N. Y. (Cornell) Agr. Exp. Station, Memoir 148, 1933.

[4] D. Burk, Ergebnisse der Enzymforschung, v. 3: 23–56, 1934. D. Burk and H. Lineweaver, *Jour. Phys. Chem.*, 38: 35–46, 1934. D. Burk, C. K. Horner, and H. Lineweaver, *Jour. Cell. and Comp. Phys.*, 1: 435–449, 1932.

[5] A description of this organism will soon appear in *Soil Science*. In this report the organism is described as a new species of Azotobacter.

[6] W. H. Willis, Iowa Agr. Exper. Sta., *Res. Bul.*, 173, 1934.

New World species, which I have seen from Bexar County, Texas, off mourning dove, *Zenaidura macroura carolinensis* (J. M. Brennan Collection); Carey, Blaine County, Idaho, off western mourning dove, *Zenaidura macroura marginella* (R. Matheson Collection); and from Pasadena, California, off the introduced and naturalized Chinese spotted dove, *Spilopelia chinensis* (Miss Josephine R. Michener Collection). Professor M. H. Swenk informs me that there is a specimen in the Department of Entomology of the University of Nebraska, taken in Nebraska, from the western mourning dove, April 20, 1920, by C. E. Mickel and R. W. Dawson. Ferris[1] recorded it from squabs of domestic pigeon at Thatcher, Arizona. I have seen many specimens from road-runner and Arizona quail, and a few from meadowlark, canyon towhee, Abert's towhee and western mockingbird. The species is known in the United States from Texas, Nebraska, Arizona, Idaho and California; and a specimen was taken in a market at Washington, D. C., off Arizona quail, evidently an accidental importation. Farther south it is recorded from Cuba, St. Croix, Grenada, Venezuela, Brazil, Paraguay and the Galapagos.

Stilbometopa podopostyla Speiser, also a strictly New World fly, is now known from Nebraska, Arizona, Texas (Bexar County, off *Zenaidura macroura carolinensis.*—J. M. Brennan Collection), Guatemala, the Republic of Honduras (Lancetilla near Tela, without host), Costa Rica (La Fuente, without host), British Guiana, Brazil and Paraguay (San Bernardino, without host). This fly is rare and host records are as yet few; but of the six species of birds from which it has been taken five belong to the dove family.

Ornithoctona erythrocephala (Leach), another fly restricted to the New World, is much more common than the Stilbometopa. It has a fairly large and varied host list. In the West Indies and tropical America it is reported from at least six species of wild doves and from domestic pigeon, as well as from a variety of other birds. Although by no means rare in North America, it has been taken there mostly from birds of prey, never from doves or pigeon. I have seen specimens from British Columbia, Alberta, the Province of Quebec, Maine, Massachusetts, Pennsylvania, North Carolina, Florida and Minnesota.

Ornithoica confluenta (Say), also strictly American, is one of the most common and most widely spread hippoboscids in this country. Its host list is very extensive, but it is most frequent on small migratory birds. Birds of prey and wading birds are probably stray hosts only. No doubt Herman's single record from eastern mourning dove at North Eastham, Mass., is likewise based on an accidental occurrence.

The pigeon fly, *Pseudolynchia canariensis* (Macquart) (Syn.: *maura* Bigot; *lividicolor* Bigot) is at present cosmopolitan. In North America it is known from Washington, D. C., South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Texas, Arkansas and California. In the New World it is often common on domestic pigeon, but has never been found on a wild host. On the other hand, it has been taken from at least eight species of wild doves in Europe, Africa and the Philippines. Evidently this was originally an Old World fly, introduced by man into the Americas.

From the foregoing it would seem that *Microlynchia pusilla* is the most likely natural vector of dove Haemoproteus in North America. This fly, moreover, transmits *Haemoproteus columbae* from pigeon to pigeon, according to H. de Beaurepaire-Aragão.[2] Both *Stilbometopa podopostyla* and *Ornithoctona erythrocephala,* although perhaps potential carriers, are probably too rare in this country on wild doves to be of much importance. *Ornithoica confluenta* is not likely to act as the vector in nature. While *Pseudolynchia canariensis* has been shown to transmit the dove Haemoproteus from dove to pigeon in the laboratory, it probably never carries it from dove to dove in nature in North America.

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STOMATAL INDEX AND TRANSPIRATION RATE OF LEAVES

BOTANISTS studying number of stomata in unit surface areas of leaves have noticed great variation between leaves from the lower to the higher levels of plants. Because of this variation it has been impossible to determine, for purposes of comparing plants in breeding work dealing with stomatal number and transpiration rate, whether a leaf at any particular level is typical. Also, it has been impossible to anticipate rate of transpiration on the basis of stomatal number.

In studying different levels of Kentucky wonder bean plants I have observed that the leaves differ significantly in stomatal number for unit surface area from the lower to the higher levels but do not differ in transpiration rate or in stomatal index. Young plants of the Kentucky wonder variety were found to be uniform for the upper epidermis transpiration rate and for stomatal index; they were not uniform for stomatal number except for the upper surface of the juvenile leaves.

In studying juvenile leaves of the Kentucky wonder, black wax and pinto varieties and four segregates of a cross between the black wax and pinto varieties I have noticed that stomatal number of juvenile leaf is not always an indication of relative transpiration rate. In comparing plants of *Phaseolus vulgaris* transpiration rate parallels stomatal index but does not always parallel stomatal number.

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[1] Ferris, *Canad. Entom.*, 62: 66, 1930.

[2] H. de Beaurepaire-Aragão, *Brasil-Medico*, 30: 353, 1916.

These observations support the view that juvenile leaves may be used to advantage for comparing plants in breeding work dealing with transpiration rate. They also support the view that transpiration rate is associated with stomatal index and not with stomatal number. Stomatal index may be determined from any of the leaves of a young bean plant.

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SOCIETIES AND MEETINGS

THE NEW YORK MEETING OF THE AMERICAN PHYSICAL SOCIETY

THE two hundred and twenty-sixth regular meeting of the American Physical Society was held in New York City on Thursday, Friday and Saturday, February 23, 24 and 25, 1939. All regular sessions of the society devoted to the reading of contributed papers were held in the Pupin Physics Laboratories of Columbia University, while the Saturday morning symposium meeting devoted to television took place in Studio 3A of the National Broadcasting Company in the RCA building at 30 Rockefeller Plaza.

On Thursday morning the Inter-Society Color Council held its business session at 480 Lexington Avenue, and the afternoon was devoted to a technical session on color tolerances, sponsored jointly by the Inter-Society Color Council and the American Psychological Association. Seven papers were presented, dealing with such subjects as the physics of color tolerance, the psychophysics of color tolerance, the representation of color tolerances on the chromaticity diagram, specification of tolerances at the National Bureau of Standards, industrial color tolerances, the ratio method in the review of Munsell colors and color tolerances as affected by changes in composition and intensity of illumination and reflectance of background. At 8:00 o'clock on Thursday evening the council held a popular session on "Parade of Color," including discussions of color in medicine, paper, textiles, industry, lighting, psychology and fashion.

The sessions of the American Physical Society were opened at ten o'clock on Friday morning with a meeting of the council and the presentation of contributed papers. A wide range of subjects was covered, falling into a number of fields. These included reports of studies of field currents at high and low pressures, of field measurements and possible correction of aberrations for magnetic electron lenses, of magnetic susceptibilities in weak fields, studies on the magnetic anisotropy of iron-nickel and copper-nickel alloys, on the theory of paramagnetic relaxation and a new approach to the problem of ferromagnetism. Studies of the structure and properties of metals included papers on the optical and magneto-optical activity of nickel sulfate, α-hexahydrate, in the short infra-red spectrum, on the preparation of single crystals of iron, cobalt, nickel and their alloys, and on the magnetic anisotropy of iron-copper and copper-nickel alloys. In the field of atomic physics there were discussions on the theoretical constitution of metallic barium, on nuclear isomers in radioactive strontium and on the band structure of metallic copper. Discussions of centrifugation and related subjects included papers on a new adaptation of the Beams ultracentrifuge for liquids, on the separation of bromine isotopes by centrifugation and on the formation and properties of unsupported flowing liquid films. Papers were also presented dealing with some physical properties of liquid and solid HD, the lack of "sucking" action by the cathode blast of mercury vapor in a pool rectifier, and the striated luminous glow of the piezoelectric quartz resonator at flexual vibration frequencies. Finally, a paper was presented by Cartwright and Turner on their interesting method of reducing the reflection from glass by deposited multilayer films.

Four contributed papers were read before the Optical Society in its session on Friday morning, which was opened at 9:30 in the Physics Laboratories. They dealt with spectro-radiography with the cathode ray tube, the first spectrum of tin, the behavior of an interferometer in a gravitational field and a calculation of the luminous efficiency of ionized cesium vapor.

A program of eighteen contributed technical papers occupied the Friday afternoon session of the American Physical Society, which was opened at the Physics Laboratory at 2:00 P.M. The program was rendered of unusual interest by discussions by Niels Bohr and Enrico Fermi of the experiments in the disintegration of uranium recently undertaken with the Columbia cyclotron. A number of other fields were treated, including those of cosmic ray studies, with papers on comparisons of counter and electroscope measurements in the stratosphere, on the origin of the rays which produce the bursts of cosmic ray ionization, and on the design and construction of reliable Geiger-Muller counters, of x-rays especially in relation to therapeutics, with papers on a compact pressure-insulated electrostatic x-ray generator for cancer therapy, on some new features in the million-volt x-ray installation at the Memorial Hospital, and descriptions of a portable gamma-ray detector and a measurement of gamma-radiation in roentgens, and of spectroscopy, with papers relating to the effect of pressure on the intensity of the recombination spectrum of mercury, the spectral distribution of energy in the recombination spectrum of mercury and the spectra of SnH and PbH at high pressure. Other discussions of structure included considerations of the binding energy of He^6 and nuclear forces, the theoretical binding energy of He^5, and the energy levels of H^3, He^3 and He^6. Papers were given concerning studies of radioactive Be^7, the self-energy of the electron, and competition between $p-n$ and $p-\gamma$ reaction, and papers were presented on such widely divergent subjects as a study of the Rossi transition curve for small angle showers in layers of iron and an electrophoretic demonstration of patent pores of human skin.

The five papers presented before the afternoon sessions of the Optical Society, which was also held in the Physics Laboratories, dealt with the physiological and psychological aspects of color perception and vision. They included studies of the comparative effect of cobra venom and opiates on acuity and field of vision, facts and theories of color blindness, an experimental determination of the spectral components of psychologically unique red, of hue, saturation and lightness of surface colors with chromatic illumination, and the effect of certain variables on hue, lightness and saturation of samples having identical trilinear coordinates.

On Friday evening a joint dinner of the societies was held at the Columbia University Men's Faculty Club.

On Saturday morning a joint session of the societies, in the form of a symposium and demonstration on television, was held in Studio 3A of the National Broadcasting Company in the R.C.A. building at 30 Rockefeller Plaza, opening at ten o'clock. Both the symposium and demonstration were striking and of great interest. The planned program had included papers by V. K. Zworykin, of the RCA Manufacturing Company, on electron optics as applied in television systems and by P. T. Farnsworth, of Farnsworth Television Incorporated, on the application of electron multipliers to television systems. It was found that Dr. Farnsworth was unable to be present, however, so Dr. Zworykin provided both papers, his first dealing with the historical development of the theory of television, his second devoted to a discussion of the present New York City installation recently completed by R.C.A. The demonstrations which followed were conducted by A. F. Van Dyke, of the Radio Corporation of America, and were of great interest, especially since installations both of the very large experimental projection receiver and of the type of receiver which will shortly be marketed for home use had been included in the studio and were operated simultaneously. The symposium was well attended.

The American Physical Society met in three sections on Saturday afternoon to hear a total of twenty-eight contributed papers. The papers presented before the first section dealt predominantly with scattering and other phenomena in the bombardment of matter by protons and neutrons, including studies of the resonance scattering of protons by lithium, the scattering of neutrons by hydrogen and deuterium molecules, the scattering of D – D neutrons, the elastic scattering of fast neutrons, and the ionization produced in gases by fast neutron irradiation. There were also discussions on the nuclear moments of the rubidium and chlorine isotopes, the electric quadrupole moment of In^{115}, the temperature in white dwarf stars, the self-energy of the electron and general relativity theory and flat space.

The papers of the second group were somewhat miscellaneous and of very wide scope. There were discussions of thermal and stress dependence of elasticity in solids, determination of the nature of a light source from wide-angle interference measurements, the measurement of x-ray production in the range 0.8 to 2.0 million volts, the uniqueness of an x-ray crystal analysis, on a general equation of state with reference to the equations for ammonia and steam, on the probability of K ionization of nickel by cathode rays, the electronic structure of alloys, inertial mass and a discussion of the difference in scope of theoretical physics and pure mathematics.

Four papers in infra-red, ultra-violet and x-ray spectroscopy were presented before the third section on Saturday afternoon. These included studies of the infra-red spectra of the fatty acids, the infra-red absorption spectrum of phenol vapor, the absorption spectrum of heavy benzene at 2730–2205 Å and a description of an apparatus for determining the orientation of crystals by x-rays. There were also papers on a re-evaluation of the atomic constants, the accommodation coefficients of helium *vs.* nickel, an investigation of the gettering powers of various metals for the gases hydrogen, oxygen, nitrogen, CO$_2$ and air, on the thermal conduction of metallic contacts, and finally on a determination of the radon content of the spring waters of Fairmount Park, the last listed paper of the meetings.

The next meeting of the American Physical Society will be held in Washington, D. C., from April 27 to 29, with a subsequent meeting in June at Stanford University, California, the date of which is still to be determined.

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SPECIAL ARTICLES

PATHOGENIC PLEUROPNEUMONIA-LIKE MICROORGANISMS FROM ACUTE RHEUMATIC EXUDATES AND TISSUES

THE inoculation of chorioallantoic membranes of chicken eggs with exudates obtained from a number of patients with acute rheumatic fever has resulted in the development of characteristic lesions which have not appeared when similar membranes were inoculated with non-rheumatic exudates. These lesions have had the same general appearance in a number of different series where the inocula have been derived from arthritic exudates, pleural exudates or an excised erythema nodosum nodule. The characteristic lesions have usually not become definite until the third to fifth serial passage; but once having appeared they have been easily induced in as many as twenty-four passages at two- to four-day intervals. The use of a 10 per cent. human serum-saline mixture as a medium in which the ground membranes are suspended has proven an important part of the technique. Macroscopically the characteristic lesions consist of granules or pearl-like bodies, often best seen when viewed from the entodermal surface. Microscopically these areas eventually appear like globular structures surrounded with flattened epithelium, but containing in their center condensed eosinophilic material, apparently derived from the mesoderm, and varying amounts of mesodermal inflammatory reaction. The bodies appear to originate in the ectoderm; as they enlarge, they press downward into the mesoderm, and often push the entoderm ahead of themselves, so that they are most easily seen from the under surface of the membrane.

Occasionally membranes have become contaminated with ordinary bacteria. Under these circumstances they have presented quite a different appearance from that described above. When bacterial contamination has occurred, the ground membrane suspension has been subjected to Berkefeld N or V filtration, which has allowed the infectious agent to pass through.

Etherized mice inoculated intranasally with rheumatic arthritic or pleural exudates and with suspensions of chorioallantoic membranes, showing the characteristic lesions described above, have sickened and developed pneumonia in which the inciting agent has been transmissible from series to series by using as inocula, ground pneumonic lungs suspended in broth. Filtrates of these suspensions, passed through Berkefeld V candles, have induced the same type of pneumonia; and from these lungs ordinary bacteria have been absent, both from films and cultures. The equivocal nature of the evidence obtained from mouse pneumonia was recognized, because of the findings of Dochez[1] and Gordon,[2] respectively, and their collaborators, and of similar results in the Laboratories of the International Health Division.[3] In all those experiments, however, the induced pneumonia did not appear until after two or more mouse lung passages, while in our experience the characteristic pneumonia appeared after the primary intranasal inoculation. Suspensions of these pneumonic lungs which had been ground have induced the same characteristic lesions on the chorioallantoic membranes as those previously mentioned.

As Dr. Albert Sabin has consulted with us frequently during his work in recovering pleuropneumonia-like microorganisms from normal mice[4] and inducing with these cultures chronic arthritis in mice,[5] we applied the cultural techniques he was using and also some of the methods employed by Kleineberger.[6] After a few sub-cultures in beef-serum-dextrose-broth or on solid media rich in serum, it was possible to grow pleuropneumonia-like microorganisms from the pneumonic mouse lungs and also from the abnormal chorioallantoic membranes. This was highly suggestive evidence that this agent had arisen from a common source—*viz.*, the exudates or lesions of patients with rheumatic fever—although the possibility was recognized that these pleuropneumonia-like microorganisms might have come from carriers among the sick mice, even though that possibility seemed improbable.

It, therefore, became important to cultivate, if possible, these microorganisms directly from rheumatic exudates; and by using the same culture media and applying the same repeated passage techniques that were used in culturing the chorioallantoic membranes and pneumonic mouse lungs, similar appearing cultures and microorganisms have been obtained from the arthritic exudate of a child early in the course of her second attack of rheumatic fever, and also from an erythema nodosum nodule excised from a patient with typical rheumatic polyarthritis. This furnished evidence that the pleuropneumonia-like microorganisms obtained from both the chorioallantoic membranes and from the mouse pneumonic lungs were probably derived originally from the rheumatic exudates.

The pathogenicity of the cultures from the three different sources is being investigated. A culture, free from ordinary bacteria, was obtained from the nineteenth chorioallantoic membrane passage where the original inoculum was a rheumatic pleural exudate. One tenth of a cubic centimeter of this culture, after four days' incubation, was injected into the vitreous of the eyes of three rabbits. Two of them developed marked iritis and also a systemic reaction indicated by diarrhea of several days' duration; the third had a panophthalmitis with some form of cocci as contaminating agents. Another set of three rabbits was inoculated with the seventh and eighth subcultures from an arthritic exudate (this culture had never undergone animal passage); one rabbit developed marked iritis and diarrhea, the second mild iritis; while the eye of the third has so far remained free from macroscopic lesions. Two out of three other rabbits inoculated with a 24-hour-old culture of the same strain developed definite iritis after 9 or 10 days; while the iritis in the first two groups appeared between the second and fifth days after inoculation and persisted from the seventh to tenth.

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[1] A. R. Dochez, K. C. Mills and B. Mulliken, *Proc. Soc. Exp. Biol. and Med.*, 36: 683, 1937.

[2] F. B. Gordon, G. Freeman and J. M. Clampit, *Proc. Soc. Exp. Biol. and Med.*, 39: 450–453, 1938.

[3] F. L. Horsfall, personal communication.

[4] A. B. Sabin, SCIENCE, 88: 575–576, 1938.

[5] A. B. Sabin, SCIENCE, 89: 228–229, 1939.

[6] E. Kleineberger, *Jour. Hygiene*, 38: 458–475, 1938.

Four series of Swiss mice, of a stock known to be free from mouse typhoid infection, were inoculated intranasally with the same cultures that had been injected into rabbits' eyes. During the following six days, animals in each set were obviously sick and had dyspnea. When autopsied on the sixth or seventh days, 3 out of 5 mice inoculated with the 4-day-old culture showed only macroscopically equivocal pulmonary lesions. On the other hand, marked pneumonia was present in 2 out of 5 mice in each of the three sets inoculated with either 1- or 2-day-old cultures. Another macroscopically normal appearing mouse lung was found upon microscopic examination to have foci of interstitial pneumonia, perivascular hyperplasia and bronchi distended with polymorphonuclear cells, a picture that has been peculiar to all the pneumonic lungs examined.

It thus appears that pleuropneumonia-like microorganisms cultured directly from rheumatic exudates can induce the same type of pneumonia in mice that is obtained by inoculating these animals with rheumatic exudates, or with suspensions of chorioallantoic membranes in which characteristic lesions have been induced by these exudates. These pulmonic lesions have appeared in the first mice inoculated with these various materials, as well as in those where serial transfers have been carried out; hence we feel that the organotropism of these microorganisms is different from those of the pleuropneumonia-like microorganisms recovered from mice by Dr. Sabin, for he has been unable to induce pneumonia in mice with his cultures.[7] A few mice inoculated either intracerebrally, intravenously or intraperitoneally with cultures have, so far, shown no characteristic lesions, even though some of them have been obviously sick. The series has been too small, however, and the time since inoculation too short for final judgment concerning the pathogenicity of these cultures.

SUMMARY

In suitable cell-free media it has been possible to cultivate pleuropneumonia-like microorganisms from the following materials, first, from chorioallantoic membranes in which lesions were apparently induced by exudates from patients with rheumatic fever; second, from pneumonic lungs of mice inoculated with similar exudates or with suspensions of the above-mentioned abnormal membranes; and third, directly from the arthritic exudate of a patient with rheumatic fever, and also from an erythema nodosum nodule excised from a patient with this same disease. With three different subcultures from joint fluid, iritis has been induced in rabbits; and following intranasal inoculation with the same cultures there has developed in mice a pneumonia similar to that found in mice inoculated with rheumatic exudates and with suspensions of chorioallantoic membranes infected with rheumatic exudates. Therefore it seems probable that in all instances the pathogenic agent was derived from similar sources, *viz.*, patients with rheumatic fever. Further work will be required to demonstrate the etiologic significance of these pathogenic agents in rheumatic fever.

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[7] A. B. Sabin, personal communication.

THE PROCESS OF CONTINUOUS DEAMINATION AND REAMINATION OF AMINO ACIDS IN THE PROTEINS OF NORMAL ANIMALS

WE have shown[1] that the feeding of *dl*-tyrosine with an increased concentration of the nitrogen isotope N^{15} to normal rats kept in nitrogen equilibrium leads not only to the incorporation of isotopic tyrosine into the tissue proteins, but also to the formation of other isotopic amino acids. This transfer of the nitrogen from one protein constituent to others could only have been due to chemical reactions, one of which must have involved the opening of peptide linkages. It was suspected that the mechanism responsible was that of deamination of tyrosine (to the corresponding α-keto acid?) coupled with the amination of another substance (α-keto acid?) to form the new amino acid. A process of this type was first proposed by Braunstein and Kritzman[2] and demonstrated in minced muscle. In our experiments the transfer of N^{15} from tyrosine into the α-amino group, but not into the ring,[3] of histidine offered strong evidence for the hypothesis that the shift of nitrogen from one amino acid to another is a normal event, which occurs at a rapid rate.

However, the possibility was not excluded that the transfer of the nitrogen of one amino acid into other amino acids is also associated with a more fundamental synthesis of the carbon chain of the latter. We are now able to offer proof of the occurrence of extensive deamination and reamination of amino acids of the proteins in normal animals, by following the fate of the amino acid *l*-leucine, which contained two different and independent isotopes, namely, deuterium in the carbon chain and N^{15} in the amino group.

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[1] R. Schoenheimer, S. Ratner and D. Rittenberg, *Jour. Biol. Chem.*, 127: 333, 1939.

[2] A. F. Braunstein and M. G. Kritzman, *Enzymologia*, 2: 129, 1937.

[3] R. Schoenheimer, D. Rittenberg and A. S. Keston, *Jour. Biol. Chem.*, 127: 385, 1939.

Four adult rats were kept on an ordinary stock diet (containing 15 per cent. casein) in nitrogen equilibrium without change of weight. To the diet was added an amount of *l-leucine* corresponding to 23 mg of nitrogen per rat per day for three days; the animals were then immediately killed by exsanguination. The leucine (possessing the natural configuration) contained 3.6 atom per cent. deuterium and 6.5 atom per cent. N^{15}; it was obtained by resolution of the synthetic racemic mixture described before.[4] While the total amount of nitrogen excreted corresponded to that in the diet, the excreta contained only 30 per cent. of the administered isotopic nitrogen, most of the remainder being incorporated in the body proteins. Only 8 per cent. was found in the "non-protein nitrogen" of the tissues.

The proteins of the liver, of the intestinal wall and of the remaining carcass were worked up separately, and the following analytically pure amino acids were isolated from the different proteins: three preparations each of arginine, tyrosine, glutamic acid, aspartic acid and leucine; two preparations of glycine and lysine, and one preparation of ornithine obtained by degradation of liver arginine. All the compounds, with the exception of the two lysine preparations, contained appreciable amounts of nitrogen isotope, a finding which corroborates our earlier observations after feeding tyrosine. The isotope concentration in the three leucine preparations was considerably higher than that of any other amino acid obtained from the same protein.

Indication of the mechanism responsible for the nitrogen transfer was obtained by the closer investigation of the leucine isolated from the proteins of the animals. The isotope (D and N^{15}) concentrations of the leucine isolated were considerably lower than those of the material fed. This was to be expected, as the dietary leucine was mixed with the ordinary leucine of the casein and with that of the tissue proteins into which the dietary leucine was introduced. If the leucine isolated from the tissues were only "diluted" by this "ordinary leucine," the ratio of the concentrations of the two isotopes in the compound should have been the same as in the material fed. The ratio ($D:N^{15}$), however, was altered considerably. It was 100:167 in the leucine administered and 100:103 in that isolated from the carcass. This result indicates that the carbon chain of leucine (characterized by the labeled hydrogen) had given up part of its nitrogen (in the present case labeled nitrogen) and in turn had "accepted" new nitrogen (which was normal). The other amino acids were obviously also involved in this process, in that they gave up normal nitrogen and accepted isotopic nitrogen from leucine.

The rapid introduction of a dietary amino acid into the tissue proteins, as well as the rapid and continuous deamination and amination of a large number of amino acids demonstrated in proteins of different organs has here taken place in normal adult animals on a stock diet. As all these reactions require the opening of peptide linkages in the protein, the finding is a new indication of the high chemical activity of the tissue proteins. The experimental details and their physiological and chemical implications will be presented elsewhere.

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A METHOD FOR PRODUCING PERSISTENT HYPERTENSION BY CELLOPHANE

IT has been found that arterial hypertension can be produced in dogs by wrapping one or both kidneys in Cellophane.

Dogs were anesthetized, a kidney freed from its bed, and after stripping off the fat on the surface, Cellophane sterilized in alcohol was gently wrapped around it and secured either with paper clips or a ligature. It is not necessary that very accurate approximation of the kidney and Cellophane occur. The kidney is gently replaced and the wound closed. This procedure may be repeated on the opposite kidney.

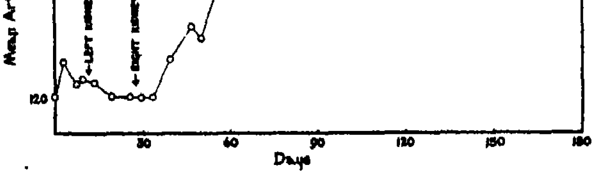

FIG. 1. Both kidneys were placed in Cellophane and blood pressure measured by intra-femoral puncture.

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[4] R. Schoenheimer and S. Ratner, *Jour. Biol. Chem.*, 127: 301, 1939.

After about two to three weeks the arterial pressure, as measured by direct intra-arterial puncture of the femoral artery, begins to rise and may reach levels as high as 240 mm Hg mean pressure after a month or two. In some animals the pressure reaches a peak and tends to fall to lower levels, while in others the pressure has remained at high levels for seven months, *e.g.*, as long as the animals have been observed. Application of Cellophane to one kidney causes hypertension, but it is not so extreme as when both kidneys are treated.

At autopsy the kidney is found to be surrounded by a dense hull of tissue (fibroblastic and collagenous) as much as 4 to 5 mm thick. This is readily stripped from the surface of the kidney.

Hypertension produced by this method occurs whether the normal capsule is stripped or not before application of Cellophane. Denervation of the kidneys also does not interfere with its development. Removal of the offending kidney in animals in which hypertension has occurred after applying Cellophane to only one kidney causes the hypertension to disappear if it has not persisted for a long time.

We have not been able to produce hypertension by applying rubber (rubber surgical glove) to the kidneys. Other organs such as the heart, liver and adrenal glands have been enclosed in Cellophane, but it is too early to be certain of the results. In three experiments the pericardium showed signs of developing a constricting envelope, but the animals died before signs of constrictive pericarditis occurred.

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THE SUCCESSFUL TREATMENT OF MENINGO-ENCEPHALITIS, ASSOCIATED WITH CANINE DISTEMPER, WITH SULFANILAMIDE

MENINGO-ENCEPHALITIS associated with canine distemper has been considered for years an incurable disease. The mortality rate reported by veterinarians is from 90 to 100 per cent. Goldberg and Volgenau[1] reported on 73 cases treated at the New York State Veterinary College with one recovery. Our records indicate the rate to be essentially 100 per cent. when the disease is accurately diagnosed.

Canine distemper produced by the virus of Carré can be readily controlled by homologous serum, which has no effect on meningo-encephalitis. Sulfanilamid has little value as a therapeutic agent for distemper, in our own experience and in that of veterinarians generally.

The specific etiological agent for meningo-encephalitis associated with canine distemper is, however, unknown. Some believe that the virus of Carré is responsible, others that it is a bacterial invasion secondary to the virus of Carré and still others that it is due to certain specific bacteria and their toxins. In our work we have been unable to demonstrate any microorganisms in the brain or spinal fluid of dogs affected with meningo-encephalitis associated with canine distemper.

We have used sulfanilamide to treat fourteen dogs suffering from meningo-encephalitis associated with canine distemper. The sulfanilamide was administered in such dosage either by mouth or subcutaneously so that the sulfanilamide blood level was maintained at not less than 15 mgms per cent. Experience has shown that it is desirable to maintain this blood sulfanilamide level and that the administration of the drug should be started in the initial stages of the disease before extensive pathological changes are manifest.

Thirteen of the dogs have made complete recoveries. This is a recovery rate of about 93 per cent. compared to a mortality rate of from 90 to 100 per cent. in dogs not receiving sulfanilamide. There was a marked and rapid clinical improvement which usually took place in from 48 to 96 hours. Dogs with total anorexia started to eat. If the temperature was elevated it returned to normal. In the affected animals there was a lymphocytic leucopenia and a polymorphonuclear leucocytosis. After treatment with sulfanilamide, there was a favorable increase in the lymphocytes and a reduction in the polymorphonuclear leucocytes. The red cell count and the haemoglobin was not altered.

A detailed report of this work will appear later in another journal.

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[1] S. A. Goldberg and R. H. Volgenau, *Cornell Veterinarian*, April, 1925.

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JOSIAH WILLARD GIBBS[1]

By Professor CHARLES A. KRAUS

DIRECTOR OF THE METCALF RESEARCH LABORATORY, BROWN UNIVERSITY

ON the one hundredth anniversary of his birth, we are here to do honor to the memory of Josiah Willard Gibbs, the greatest physical scientist that America has produced and one of the greatest original thinkers of all time. The occurrence of genius is commonly believed to be a phenomenon of pure chance, and such it may well be so far as native talent is concerned; but talent has merely a potential value; it is fruitful only when it is properly cultivated, indeed, we may say when it is self-cultivated under favorable conditions. Genius may be assisted in this process of self-cultivation but, in all cases, genius flourishes best in an environment of complete intellectual freedom. The history of American science bears this out.

Let us review, briefly, the careers of the American men of genius who contributed to the development of physical science from Colonial times up to the last quarter of the nineteenth century. Up to 1880, America had produced five great physical scientists: Benjamin Franklin, Benjamin Thompson (Count Rumford), Joseph Henry, Henry A. Rowland and Josiah Willard Gibbs.

Franklin and Rumford were products of pre-revolutionary America; they were self-taught, having received only very meager common school education. The two men, although their lives were, in certain respects, very diverse, had much in common. Both were exceptionally versatile; both we[illegible] observers and ready experimenters; both wer[illegible] practical and inventive turn of mind; both were keenly conscious of their social environment and both did much to advance science and learning in other ways than through their scientific contributions. Franklin was active in promoting the establishment of libraries, colleges and learned societies—notably, the American Philosophical Society; Rumford founded the Royal Institution, whence came the epoch-making researches of Davy and Faraday.

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[1] An address delivered in Yale University on the occasion of exercises held in commemoration of the one hundredth anniversary of the birth of Josiah Willard Gibbs.

Joseph Henry received his formal education, such as it was, at Albany Academy. He began his scientific work while a teacher at the Albany Academy, where he remained until 1832 when he removed to Princeton. In 1846, he resigned his professorship at Princeton to become the first secretary of the newly founded Smithsonian Institution. Henry began his researches in electromagnetism while in Albany and continued them at Princeton. He was a genius of first rank, but his work has been rather overshadowed by that of Faraday.

Henry A. Rowland prepared for college, or attempted to do so, at Newark Academy. Although a brilliant student in other subjects, he had a keen distaste for Latin which he was unable to overcome. After a final unsuccessful effort to master Latin and Greek, at Andover, and lacking the necessary knowledge of these subjects for college entrance, Rowland entered the Rensselaer Polytechnic Institute, where he remained for three years. He then spent a year in the Sheffield Scientific School, at Yale, and returning to the Rensselaer Polytechnic Institute, he received his baccalaureate degree in civil engineering from that institution in 1870. Rowland was nine years younger than Gibbs, but his scientific work was contemporaneous with that of Gibbs's. Rowland's first great undertaking was an accurate redetermination of the mechanical equivalent of heat, the first determination of which had been made by Count Rumford three quarters of a century earlier. In the field of heat, American scientists have made greater contributions than in any other branch of physical science. It might be said that Rumford began the solution of the problem of heat, and Gibbs completed it.

Gibbs entered Yale College in 1854, after preparing at the Hopkins Grammar School of New Haven. He was evidently proficient in the classical languages, since, as an undergraduate at Yale, he took prizes in Latin and gave a Latin oration on graduating. He seems to have had an equal facility in mathematics, for he likewise took prizes in that subject. After graduating from Yale, in 1858, he entered the graduate school, where, after five years, he received his doctorate in 1863. After spending the following three years as a tutor in Yale College—two in Latin and one in natural philosophy—Gibbs went abroad, spending the winter of 1866–67 in Paris; the summer and winter of 1867–8 in Berlin and the summer and winter of 1868–9 in Heidelberg. He returned to America in June, 1869, and for two years thereafter seems to have had no academic connections. In 1871 he was appointed professor of mathematical physics in Yale University, which position he held until the time of his death, on April 28, 1903.

It is an interesting fact, and it would seem a significant one, that of the five men, native of America, who achieved distinction in physical science, two were self-taught, one received his education in a small academy and a fourth in a technical school; only one was the product of one of our better American colleges. Is it that men of potential genius did not enter the numerous American colleges during the Colonial and the post-revolutionary periods or is it that the course of training which these colleges thought fit to impose upon their students unfitted them for great achievement? Is the probability not that, while men of genius in America were able to overcome the handicap of lack of means, lack of education and lack of technical training, they were not able to resist the blighting influence of eighteenth and nineteenth century scholasticism? Gibbs, alone, stands out as a notable exception. May it have been that there was something in the organization of Yale College that permitted Gibbs to cultivate his mind and to find free scope for his brilliant intellect? With his ready facility in the ancient languages and, doubtless, in other subjects as well, and with his excellent preparation, Gibbs probably found much time in which to inform himself on subjects that did not appear in the curriculum of Yale in his day. It is also a notable fact that he spent five years in the Yale graduate school, the first organization of this kind in America. Here, without doubt, Gibbs found further opportunity to follow his own bent. His experience as a tutor can hardly have been a profitable one; his mind, obviously, was not interested in the classics, and there is little doubt but that Gibbs was much more interested in the development of science than he was in teaching undergraduates. Later, when he was professor of mathematical physics, he never showed any inclination to simplify his presentation of a subject or to give introductory courses for students who were not prepared for subjects as he presented them.

During his stay abroad, Gibbs must have informed himself very widely with respect to the physical sciences and trained himself in mathematics. The records show that, while in Berlin, he attended lectures in physics and technology, under Magnus; acoustics, under Kundt; electricity and electromagnetism, optics, acoustics and capillarity, under Quincke; determinants and analysis, under Weierstrass; quadratic forms and probability calculations, under Kronecker; and least squares, under Foerster. It is not known what lectures he attended while in Heidelberg, but, judging by the lectures that he attended in Berlin, it is safe to say that he attended many lectures under the notable men who were at the University of Heidelberg at that time. These included: Professors Rummer, Cantor, Hesse and Drs. Lüroth, Weber, du Bois Raymond and Eisenlohr, in mathematics, and Professors Kirchhoff, Helmholtz, Bunsen, Kopp and Dr. Horstmann, in physics and chemistry.[2]

Examining the record, we see that between 1858, when he graduated from Yale College, and 1871, when he entered upon his professorship of mathematical physics in Yale University, Gibbs spent ten years in preparation for his life work, not counting the three years which he spent as tutor in Yale College. The conclusion that one may draw from this is that the preparation which our American colleges afforded men of science in the nineteenth century was not necessarily fatal to the development of their genius, provided that they were able to devote sufficient time to their training afterwards. Gibbs, fortunately, was financially independent and was, therefore, able to follow his own bent. This was not true of the great mass of men in that day, as it is not true of the great mass of men in our colleges to-day. We may well ask ourselves the question: Are our colleges quenching the genius of our outstanding students through the formal curricula that they impose upon them and through the lack of opportunity for their self-development?

By training and tradition and by the force of the environment in which he was placed, Gibbs should have developed into a typical exponent of nineteenth century scholasticism. That he did not become such was in part due to his own intellectual and financial independence and in part, without doubt, to certain favorable conditions that existed at Yale in the 1850's and 60's.

Gibbs, like Franklin and Rumford, had a strong leaning toward science, with a turn toward invention; in 1866, while still a tutor in natural philosophy in Yale College, he invented a brake for railway cars and secured a patent for the same in April of that year.[3] At about that time, also, he invented a new type of governor of a higher order of approximation to astaticism than any of its predecessors. This governor was constructed in the shops of the Sheffield Scientific School and is in the collection of the Department of Physics of Yale University.[4] Until we have come to know that Gibbs was endowed with a mind which possessed a keen appreciation of and interest in things physical and practical, his life and works remain a profound mystery. Possessing intellectual powers of the highest order, as much at home in pure mathematics as in physics and chemistry, Gibbs constantly exercised his will to direct his thoughts along lines that lay within the framework of material phenomena.

It has often been stated that Gibbs never carried out an experiment. This statement is not borne out by the facts; it is known that Gibbs constructed some apparatus in his own home.[5] According to Professor Charles S. Hastings, in his Biographical Memoir on Gibbs in the National Academy of Sciences, Gibbs carried out an optical experiment. How many other experiments he may have carried out, no one can say, for Gibbs communicated to others only the results of major investigations. Speaking of this experiment, Professor Hastings, after reviewing its general purpose, says:

> . . . the tentative explanation, however, involved the occurrence of certain phenomena in specular reflection which had never been seen or, at last, recorded. As it did not seem to him that such negative evidence was conclusive, he constructed an apparatus with his own hands so perfectly adapted to the end in view that his observations afforded the proof sought. A striking light is thrown upon the character of the great physicist by the fact that no reference to this theory, which must have cost much critical study, appears in his writings, nor is it known that anyone except the present writer ever saw the apparatus and made the experiment for which it was designed.

In the main, Gibbs depended upon experimental results available in the literature for data with which to test his theoretical investigations. That he was familiar with the literature and quick to make use of results there available is shown by examples that appear in his treatise of 1876–8, as well as in numerous subsequent papers. His chief interests were theoretical, and his physical sense was so keen that he could frame correct physical concepts with a minimum of experience with the phenomena themselves. In this Gibbs was highly exceptional; he introduced many new and exact concepts into science long before any observations relating to them had been made.

For fifty years, now, we have been hearing much and often about the manner in which American science, in general, and Yale University, in particular, failed to recognize Gibbs and his works. The explanation is simple: Gibbs was half a century in advance of his time and American scientists of his day were ill-prepared to comprehend the abstract philosophical results of Gibbs's theory. Much the same thing was true throughout the world; it seems that at the time of their publication, or soon thereafter, only two men comprehended the significance of Gibbs's work. One was Clerk Maxwell, who immediately called attention to the first two papers of Gibbs; in his "Theory of Heat," Maxwell incorporated a chapter dealing with the Gibbs surface. As is well known, Maxwell constructed several models of this surface with his own hands, one of which he sent to Gibbs. Maxwell also called attention to Gibbs's later paper of 1876. Had Maxwell lived, Gibbs's theory would have become known to the scientific world much earlier than it was.[6] Another physicist who early recognized the significance of Gibbs's contributions was J. D. van der Waals, Sr. He called Roozeboom's attention to the paper on heterogeneous equilibria, and this led to the development of the phase rule in the hands of Roozeboom and his associates. Van der Waals, himself, throughout his life, was active in developing the consequences of Gibbs's theory, as is evident from his admirable text with Kohnstamm, entitled "Lehrbuch der Thermodynamik," published in two parts, the first in 1908 and the second in 1912.

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[2] There is no certain record of what lectures Gibbs attended in Paris, but Gibbs's own copies of lists of courses offered at the Sorbonne bear pencil marks against certain courses which were probably the ones Gibbs expected to attend, and perhaps did attend up to the time of his illness while in Paris. The marked subjects are: *Astronomy*, Puiseaux; *Calculus of Probability and Mathematical Physics*, Lamé or Briot; *Physics*, P. Dessains; *Rational Mechanics*, Liouville; *Differential and Integral Calculus*, Serrer; *Chemistry*, Balard. (For the information concerning Gibbs's studies while abroad, the writer is indebted to Professor R. G. Van Name, of Yale University.)

[3] U. S. Patent No. 53,931, April 17, 1866.

[4] Charles S. Hastings, Biographical Memoirs, Nat. Acad. of Sci., 6: 375, 1909. It is interesting to note that among Gibbs's papers was found a manuscript entitled "On the Form of the Teeth of Wheels in Spur Gearing." It has been suggested that this was a copy of Gibbs's thesis for the doctorate, but this is not certain; it does, however, bear witness to Gibbs's early interest in mechanical problems.

[5] Professor Van Name reports an apparatus that Gibbs so constructed for an optical experiment, but it is not known what the nature of this experiment was.

That Gibbs's ability was recognized at Yale University is evident from the fact that he was appointed professor of mathematical physics in 1871 before he had published a single paper. Gibbs was early recognized by his contemporaries in America, being elected to the National Academy in 1879 and awarded the Rumford Medal in 1881. It is true, however, that while Gibbs's ability was generally recognized by his American contemporaries, his scientific contributions were not understood.

How Gibbs came to interest himself in the thermodynamics is not known; that he should have done so is not surprising. The two fields of physics that engaged the attention of physicists during the greater part of the nineteenth century were electromagnetic phenomena and phenomena relating to heat. Judging by the subjects upon which he lectured during 1871–2 and 1872–3, Gibbs at that time was interested in physical optics, particularly the elastic solid theory. According to Hastings, he arrived at the conclusion that the obstacles in the way of this theory were insuperable. Later, he was a proponent of the electromagnetic theory of Maxwell at a time when many other eminent physicists were reluctant to accept it.

Phenomena relating to heat were intensively cultivated by physicists from 1842 onward. The classical researches of Rumford had been forgotten for nearly half a century, when they were independently repeated and extended by Joule between the years 1837 and 1843. Mayer published his paper on the equivalence of heat and work in 1842. As early as 1824, Carnot had enunciated his celebrated principle,[7] now known as the second law of thermodynamics, but the significance of Carnot's principle was not recognized until the relation between heat and work had been clarified in the 1840's. The concept of absolute temperature was established in two papers by Sir William Thomson in 1848 and 1851. In 1851, Clausius combined the principle of Carnot with the principle of the conservation of energy, which, by then, had been well established through the experiments of Joule. Thereafter, many physicists were active in developing the elements of thermodynamics, applying the two principles—that of Carnot and that of the conservation of energy—almost exclusively to one-component systems. Clausius introduced the entropy concept in 1865. By 1870, the framework of thermodynamics had been erected and its application to one-component systems developed. The literature relating to thermodynamics was, however, in a state of confusion; concepts were not clear, physical quantities were not well defined and the mathematical manipulations were cumbersome and unsuited for the purpose of describing the thermodynamic properties of physical systems generally.

It was natural that Gibbs, who doubtless was well acquainted with the literature of his day, should have become interested in a field where it was apparent that much remained to be done. In his first two papers of 1873, he developed the methods and forged the tools that he later used in treating physical systems from a very general point of view. He introduced the entropy concept and showed that a better description of phenomena is obtained by means of the energy-entropy-volume relation than by means of the pressure-temperature-volume relation. He showed how the state of a body may be represented by means of the energy-entropy-volume surface, every point of which corresponds to a definite state of the substance. He showed how, by means of this surface, the boundary between stable and metastable states may be readily traced, as also the boundary between metastable and unstable states, and showed, moreover, how states capable of existing in equilibrium with one another may readily be derived from the surface. By means of this surface, it is possible, at a glance, to obtain a picture of all the possible states of a physical system.

The first two papers were only preliminary to the third, which appeared in two parts in 1876 and 1878, respectively; in these, Gibbs treated systems comprising any number of substances—which might or might not interact with one another—existing in any number of homogeneous parts or states of aggregation.

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[6] It is of interest to note that Rowland's first paper on the magnetic circuit was not accepted for publication by American editors. Rowland sent the paper to Maxwell, who recognized its value and sent it to the *Philosophical Magazine*, where it was published immediately, Maxwell himself reading the proof in order to avoid delay. Only another genius can recognize genius.

[7] Carnot's principle states that it is impossible to transfer heat from a lower temperature to a higher without the performance of work or, otherwise, leaving compensating changes in the system or its surroundings.

Previous to Gibbs, the concept of reversibility, which means equilibrium at all points of a process, was clear, but the concept of equilibrium in a heterogeneous system was still vague. For very simple systems, such as water, the equilibrium conditions were recognized and James Thomson had shown that at the natural freezing point of water, three monovariant systems meet. The concept of equilibrium in a highly complex system, involving any number of component substances, had not been touched upon prior to Gibbs. Obviously, before being able to attack this general problem of equilibrium, it was necessary to have a criterion of equilibrium. Gibbs was well versed in mechanics, and it was, therefore, natural that he should seek for some general principle, similar to the principle of virtual displacements in mechanics, which might be applied to chemical systems. That he was influenced by the earlier work of Clausius seems certain, for at the head of his treatise "On the Equilibria of Heterogeneous Substances," he quotes a couplet from Clausius:

> Die Energie der Welt ist konstant.
> Die Entropie der Welt strebt einem Maximum zu.[6]

The statements of Clausius are physically meaningless. Gibbs formulated the underlying idea in a form such that it could be applied to real physical systems. He states the condition for equilibrium alternatively as follows:

> I. For the equilibrium of any isolated system it is necessary and sufficient that in all possible variations of the state of the system which do not alter its energy, the variation of its entropy shall either vanish or be negative.
>
> II. For the equilibrium of any isolated system it is necessary and sufficient that in all possible variations in the state of the system which do not alter its entropy, the variation of its energy shall either vanish or be positive.

We know nothing about the energy and the entropy of the universe; we have knowledge only of finite physical systems which we can place under observation and over which we have control; therefore, Gibbs limits his system to what he terms an "isolated system" and applies his criteria for equilibrium, which follow directly from the first and second laws of thermodynamics. Gibbs shows that the two criteria, as stated above, are strictly equivalent.

Having set up criteria of equilibrium, it was necessary to define the various thermodynamic quantities, particularly the energy and entropy in terms of the variables that fix the state of the system. The concept of an equation of state was not thoroughly familiar to physicists in Gibbs's day, although it is clear that, since Andrews had already carried out his classical experiments with carbon dioxide and James Thomson had already arrived at the p,v,T surface as representing the possible states of a system, it was generally understood that the state of a simple substance is determined by these three variables. Gibbs, in his earlier paper, had shown that Thomson's representation is incomplete and that certain important thermodynamic quantities may not be derived from such a surface. It was for this reason that he introduced the energy-entropy-volume surface which gives a complete description of all thermodynamic properties of a substance.

In the case of a system containing any number of substances, it was not obvious what variables fix the state of the system. Gibbs assumed (implicitly) an equation of state involving pressure, temperature and the relative amounts of the independently variable substances present. It was then necessary to derive an expression connecting the changes in energy with changes in entropy, volume and the amounts of the various substances in the different homogeneous aggregations of matter. To do this, he introduced a new concept, namely, the thermodynamic potential, which is the derivative of the energy with respect to the mass of a given component, other variables remaining constant, so that for a given homogeneous aggregation of matter, the energy is related to the variables which fix the state of the system by a differential equation of the form:

$$d\epsilon = Tds - pdv + \mu_1 dm_1 + \mu_2 dm_2 \ . \ . \ . + \mu_n dm_n$$

where the μ's are the thermodynamic potentials of the various substances present and ϵ, s and v are the energy, entropy and volume, respectively, and the m's are the masses of the constituent substances. The thermodynamic potentials, μ, together with entropy and volume, are functions of the variables T, v and the masses, m_1, m_2, . . . m_n, of the constituent substances in the different aggregations of matter which comprise the system. It is understood that the masses are independently variable and that substances may be present other than those which have been chosen as independent variables; but whatever variables may be chosen, they must be independent. Gibbs next assumed that, for a heterogeneous system, the total energy of the system is made up of the sum of the energies of all the different homogeneous parts which exist in equilibrium with one another or, as he says, *coexist*. The various homogeneous aggregations of matter, each of which has a definite equation of state, he calls *phases* and two aggregations of matter, having the same equation of state, belong to the same phase. The independently variable substance he calls *components*. What particular substances are chosen as components is arbitrary so long as they are always independent and serve to build up all the different phases of the system.

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[6] The energy of the universe is constant. The entropy of the universe approaches a maximum.

Having arrived at a means of defining the energy and entropy of the system, Gibbs proceeds to apply his criterion for equilibrium, namely, that the energy of the system shall be a minimum under the conditions that the total volume, the total entropy and the total masses of the several components of the systems remain constant. This leads to the result that equilibrium obtains in the system when the temperature of any one phase is equal to the temperature of any other, the pressure of any one phase is equal to the pressure of any other and the thermodynamic potential of any one component in any one phase is equal to the thermodynamic potential of the same component in every other phase.

The variables of the system are the temperature, the volume and the relative amounts or concentrations of the several components in all the different phases; in order that equilibrium shall be established, these variables must adjust themselves in such a way that the condition for equality of the thermodynamic potentials of the several components throughout the system is fulfilled. This condition of equality of the thermodynamic potentials of each of the several components in the different phases thus represents a multiplicity of conditions which must be satisfied by the variables; and when the number of independent conditions is equal to the number of variables, the system is completely fixed or, as we say, is *invariant*. Gibbs showed that a system will be invariant when the number of phases, r, is equal to the number of components, n, increased by two, or algebraically, when $r = n + 2$. When the number of phases is only one greater than the number of components ($r = n + 1$), one variable of the system may be fixed arbitrarily at any desired value within the physical limits of the system; such a system is said to be *monovariant*. When $r = n$, two variables may be arbitrarily fixed and the system is said to be *bivariant*.

We may illustrate the phase rule in the case of a system built up of only one substance, that is, a system of one component. Consider a system composed of pure water. Three phases (three different states of water) may coexist at a certain temperature which is an invariable property of water. We may, for example, have water vapor, liquid water and ice coexisting at the triple point, which is 0.0076° above 0° on the Centigrade scale, and at that temperature only. If the temperature is increased, ice melts and we have an equilibrium between liquid water and water vapor which may exist at a series of temperatures and pressures. If the temperature is lowered, liquid water freezes and we have a similar equilibrium between ice and water vapor; if the pressure is increased, vapor is condensed and we have an equilibrium between ice and water, the temperature diminishing with increasing pressure. At higher pressures, a new form of solid water (ice_{II}) appears and we have an invariant equilibrium between ice_{I}, ice_{II} and liquid water.

Gibbs also considered equilibria in systems in which reactions occur among various of the molecules present. He derived a relation governing the equilibrium in such systems and showed how, in the case of dilute systems, this leads to a simple relation between the concentrations of the various substances concerned in the reaction. In brief, Gibbs, from thermodynamic considerations, derived the law of mass action which had earlier been arrived at by Guldberg and Waage on the basis of kinetic considerations. He showed, moreover, how this equilibrium depends upon temperature. In the earlier chapters of his treatise, Gibbs considered external forces to be excluded from his system; later he investigated what modifications are required when external forces act. He thus investigated the action of gravitational force, of electrical forces and surface forces. Very important was his treatment of systems under the action of electrical forces; he showed, what was not then recognized, that in such systems the energy change is not equal to the work done against the external forces, but, rather, that it is equal to the sum of two terms: (1) the reversible work done against the external forces and (2) the reversible heat change which is equal to the product of the absolute temperature and the entropy. In these considerations, he anticipated Helmholtz, who arrived at much the same result in 1882. Even more important and original were Gibbs's contributions in the field of surface forces. Here Gibbs invented entirely new concepts which had never been thought of before and which have since been found indispensable in describing phenomena that occur at the boundary between two phases of multicomponent systems.

It is not possible to give an adequate picture of Gibbs's contributions in brief form. His papers on thermodynamics cover some 400 pages and are written in a highly condensed, although elegant, style. An adequate commentary on the thermodynamic theory of Gibbs would require several thousand pages.[9] Nor are Gibbs's contributions to thermodynamics his only important contributions; he was active in many other fields, particularly in vector analysis, multiple algebra and the electromagnetic theory. The most important of his other contributions, however, is his treatise on statistical mechanics, which was published in 1902. Here, as in his treatise on thermodynamics, he reduces his assumptions to the very minimum and arrives at results of the greatest generality.

The generalizations of Gibbs concerning heterogeneous equilibria have exercised an influence upon chemistry which is second only to that of the law of the conservation of mass. Although some of the relations that follow from Gibbs's theory were subsequently discovered independently by other investigators, these were derived in a much less general manner than by Gibbs, and not infrequently they were applied when limiting assumptions (often implied) were not fulfilled and the results obtained were misleading. At the time of Gibbs, chemists concerned themselves very little with the physical properties of chemical systems; physical chemistry, as such, had not yet come into being and chemists were largely concerned with the development of organic chemistry. As physical chemistry developed during the 1880's, and later, Gibbs's work gradually came to the notice of physical chemists and the thermodynamics of Gibbs slowly replaced the earlier and less rigorous and elegant formulations. Except for certain new material and many examples, all of which fit into the framework of Gibbs's theory, modern texts on thermodynamics are essentially commentaries on Gibbs's thermodynamical theory.

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[9] Compare, for example, "Commentaries on the Scientific Writings of J. Willard Gibbs," Volume I, Thermodynamics, Yale University Press, New Haven, 1936.

Of all the relationships following from Gibbs's thermodynamical theory, the simplest and, at the same time, the most general, is the phase rule. With the aid of the phase rule, it is possible to arrive at a knowledge of the constitution of material systems and the relation of various parts of such systems to one another without destroying the systems themselves. In many respects, it is a more powerful tool than is chemical mass analysis, which is useful only if the systems in question may be resolved into their component parts without changing their nature and composition. In the case of metallic systems, for example, which are frequently very complex and the component parts of which can not be separated from one another by analytical means, the phase rule enables us to determine the composition and number of substances present and the influence which these substances have on the properties of the material in question. Take such a simple case as that of carbon steel: here we have to do with iron in its several forms, together with several kinds of solutions of carbon in iron and with free carbon. Mass analysis enables us only to determine the gross composition of the steel; with the aid of the phase rule, we can determine the different kinds of substances present, how they may be transformed into one another by change of conditions, and how the properties of the steel depend upon the various substances present and the history of the sample of steel.[10] As an example, however, carbon steel is an oversimplified case of a metallic system; modern steels are extremely complex, containing, in addition to carbon, various amounts of such elements as tungsten, molybdenum, tantalum, uranium, chromium, nickel, silicon, titanium and many others. The detailed structure of these steels has been determined with the aid of the phase rule.

What is true of the alloys of iron is true of the innumerable alloys of other metallic elements such as magnesium, aluminum, zinc, copper, tin, nickel, chromium, antimony, bismuth, platinum, gold and the like. These alloys have proved invaluable in modern industry. Except for the availability of such alloys designed to meet the needs of special conditions, modern machines, such as the automobile, the aeroplane and the streamlined railway train, would not be practical.

The phase rule finds application, also, in the ceramics industry, in the cement industry and, particularly, in the chemical industry. In the oil industry, for example, it is necessary to separate very complex liquid mixtures into various components having desirable and necessary properties. The present art of the separation of hydrocarbon oils, by distillation, by solvent extraction and by other means, is based upon the phase rule.

I have discussed the phase rule somewhat in detail, as an example, but Gibbs's theory leads to many other important consequences. The laws governing the equilibrium in reacting systems follow directly from this theory. So, also, Gibbs's theory provides a foundation for the treatment of colloidal systems. Much remains to be done in this field, but Gibbs has provided the fundamental concepts by means of which the problems of colloid chemistry may ultimately be resolved. The unravelling of the nature of living systems, which are largely colloidal in nature, involves surface phenomena that are amenable to Gibbs's theory.

Because Gibbs was a man of retiring disposition and was very much preoccupied with his important researches, he had no large circle of friends and entered into no active correspondence with other investigators. We may, therefore, be misled into undervaluing Gibbs's versatility and his ability in directions other than those which he chose to follow.[11] A paragraph from the Biographical Memoir of Josiah Willard Gibbs by Professor Hastings throws much light on this situation. He writes:

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[10] The phase rule is normally applied in conjunction with other physical observations such as crystalline structure, electrical, magnetic and mechanical properties.

[11] A number of statements in the literature relating to Gibbs are without foundation. Such a one is the statement that he was a student of Clausius. Clausius was at Wurtzburg when Gibbs was at Heidelberg and there is nothing to indicate that Clausius and Gibbs ever met. Another statement that gives quite an erroneous impression of Gibbs's character and of his home relations is to the effect that Gibbs was pressed into service by his sister to drive the family carriage because her husband, who was librarian at Yale, was too busy to do this. The truth of the matter is that Gibbs took very little exercise, walking only between his home and his office in the Sloane Laboratory. The members of his family, therefore, took advantage of every opportunity to induce Professor Gibbs to get out of doors. He rather enjoyed driving the family carriage and occasionally rode horseback as well.

> It will surprise no reader of the numerous biographical notes concerning Professor Gibbs to learn that a man of so judicial a temperament was a very successful man of affairs. Happily for science, his position in the University was not such as to render that fact conspicuous, else he might have been called upon for work which, in view of his consciousness (conscientiousness) and inherent modesty, could easily have seriously interfered with his scientific pursuits. He did, however, give his services as a trustee to the affairs of the Hopkins Grammar School of New Haven, and he acted for many years (17) as treasurer of its funds, which had come down in part from colonial times.

Gibbs was extremely painstaking in everything that he did and pronounced judgment only after mature consideration. In faculty meetings, he spoke seldom, but when he spoke, it was to the point. It is said that on one occasion, after a lengthy discussion as to the relative merits of the languages and mathematics, Gibbs said: "Mathematics is a language too." Gibbs was kindly in disposition, considerate and ready to be of help to his students. He had a sense of humor and smiled easily. He never sought for honors or advancement except as they came through recognition of his work. Such honors came to him in great abundance. They need not be enumerated here; I mention only the Copley Medal awarded him by the Royal Society of London, in 1901. He was made an honorary member of nearly every scientific organization of note and received honorary degrees from many of the leading universities of the world.

Outstanding qualities of Gibbs's character are his modesty and his devotion to science. He had not a few traits in common with Michael Faraday. At the beginning of the most productive period of his career, Faraday renounced all consulting work, from which he derived an income of from 500 to 1,000 pounds per annum—his salary at the Royal Institution was 100 pounds; for nine years following his appointment as professor of mathematical physics at Yale, Gibbs served without compensation. Gibbs, like Faraday, had great physical insight. Faraday, without mathematical training, invented the concept of the electromagnetic field, which later provided Maxwell with the foundation for the electromagnetic theory; Gibbs, with little experience with material systems, invented new physical concepts, that have served as a basis for the development of chemistry during the past fifty years.

Of the inner workings of Gibbs's mind, we know little; he left behind few letters and no notes. We can best judge the quality of the man by what he said of his colleague, Hubert Anson Newton, in the Biographical Memoir which he wrote for the National Academy of Sciences. Here, in speaking of his friend, he unconsciously reveals himself. After discussing Professor Newton's scientific contributions, Gibbs writes:

> But these papers show more than the type of mind of the author; they give no uncertain testimony concerning the character of the man. In all these papers we see a love of honest work, an aversion to shams, a caution in the enunciation of conclusions, a distrust of rash generalizations and speculations based on uncertain premises. He was never anxious to add one more guess on doubtful matters in the hope of hitting the truth, or what might pass as such for a time, but was always ready to take infinite pains in the most careful testing of every theory. With these qualities was united a modesty which forbade the pushing of his own claims and desired no reputation except the unsought tribute of competent judges.

These words of Gibbs characterize Gibbs himself much more truly than anything that I might hope to say.

OBITUARY

PROFESSOR S. P. L. SORENSEN

THE American students who were privileged to work with Professor Sørensen and the many who found inspiration in his scientific articles regret the death of this distinguished scientist on February 12.

Sørensen succeeded Kjeldahl as director of the chemical division of the Carlsberg Laboratory, in Copenhagen. Each of these men, in addition to many other contributions, hit upon something that has made his name a household word in chemical laboratories.

It would be trivial to say that Sørensen introduced the symbol p_H^+ for a unit in a scale of acidity. The significance of the fact that this symbol has become almost as common as that for degree centigrade pertains to an aspect of science that too often is neglected. By means of his logarithmic scale Sørensen was able to place on one chart or one sort of chart several of the relations in acid-base systems that were known in principle but that had not vividly impressed potential users of the theory. In terms of his new exposition Sørensen evaluated those stable mixtures of acids and their salts that are called buffer mixtures and the zones of transformation of many indicators. Having systematized the indicator method of determining pH values Sørensen revealed something of its wide usefulness by resolving an old problem in enzyme chemistry, namely, the dependence of the activities of specific enzymes upon the degrees of acidity of the solutions. Here, then, in the classical paper "Études Enzymatiques," II (1909), supplemented by a more detailed mathematical analysis in 1912, was presented that rare combination of a vivid exposition of principles, exact quantitative data that not merely illustrated the principles but also were immediately applicable as standards of reference and an illustration of the applications of a tool.

Largely because of this excellence of exposition, elaborated by Michaelis and others, there followed one of the most remarkable movements in the history of science. Every science having to do with water solutions soon instituted the measurement and control of "hydrogen-ion concentration" by the methods that Sørensen polished and in the terms that he introduced.

At a time when protein solutions were regarded as subject to study only by the unique methods of colloid chemistry Sørensen boldly applied the classical methods that work well in the study of the simple amino acids. Here, however, were problems requiring meticulous regard for detail, and because he had regard for what the problem demanded Sørensen's papers on protein solutions make difficult reading. In them will be found many of the bases of modern work, notably the application of Gibbs's phase rule in determining the homogeneity or heterogeneity of protein preparations, and the characterization of proteins by their isoelectric points and other indices of their properties as amphoteric electrolytes.

The meticulous exactitude that Sørensen displayed in his work on proteins is characteristic of his work as a whole—work that extended to analytical methods on the one hand and to organic synthesis on the other.

Born on a small farm near Slagelse on Sealand, Denmark, Sørensen developed early a penchant for science. He twice won the university's gold medal for outstanding work in science at the University of Copenhagen. After serving as assistant chemist in the Royal Technical College he became director of the chemical division of the Carlsberg Laboratory two years after receiving his doctor's degree in 1899. He became president of the Danish Academy of Sciences and last year was made a foreign associate of our National Academy of Sciences. He had honorary degrees from many universities.

In 1924 Professor Sørensen and his wife, with whom he had then and has since published several papers on proteins, visited America. We who had drawn inspiration from the written word were then impressed anew by this charming couple. Of a retiring disposition Professor Sørensen was every inch the gentleman who commanded respect by the quality of his thought and who won affection by the kindliness that shone in every glance and gesture.

Wm. Mansfield Clark

The Johns Hopkins University
School of Medicine

FABIAN FRANKLIN

Fabian Franklin was born in Eger, Hungary, on January 18, 1853. He obtained his Ph.B. degree from Columbian University (now George Washington University) in 1869 and entered the department of mathematics of the newly established Johns Hopkins University in 1877. He remained at the university as fellow from 1877 to 1879, assistant from 1879 to 1882, associate from 1882 to 1889, associate professor from 1887 to 1892 and professor of mathematics from 1892 to 1895, at which time he resigned his position to enter professionally the field of journalism. He died on January 8, 1939.

Professor Franklin was a very unusual and inspiring teacher. After a lapse of almost half a century former students still remember how clear and satisfying his lectures were. He was never content to expound a theory as it was developed by its author, and his hearers had the distinct impression that the matter being presented had been thoroughly digested by the lecturer and carried the stamp of his individuality and artistic nature. He was most conscientious and painstaking with his students, frequently going to great pains to answer a question whose import the student barely realized. His simple demeanor and dignity of person commanded the instant respect of his students, a respect which was never lost.

In his mathematics itself were reflected the wide interests of his inquiring mind. This was a definite fault of his genius. To leave a mark in mathematics requires an *esprit de suite* which doggedly pursues to the bitter end some path into the unknown. The professional mathematician, on noting a characteristic flash of genius or originality in one of Franklin's short papers, may well wish that he had not been so versatile nor so interested in politics or world affairs; but such wishes are idle. In the short period of some fifteen years before he definitely abandoned mathematics for journalism, he published some thirty papers, most of which appeared in the *American Journal of Mathematics* or the Johns Hopkins University circulars. His earlier work on invariant theory shows clearly the influence of Sylvester, whilst his papers on circular coordinates and on bicircular curves demonstrate his geometrical insight. His elementary proof of a theorem on partitions has become classic.

In 1895, when Franklin was forty-two years old, he retired from his professorship of mathematics at the Johns Hopkins University to become editor of the Baltimore *News*. Later he became associate editor of *The New York Evening Post* and editor of the *Weekly Review*. He was a distinguished writer on economic, social and political subjects. His wife, Christine Ladd-Franklin, known for her work in psychology and logic, died in 1930.

F. D. Murnaghan

The Johns Hopkins University

EARL E. HOOVER

Earl E. Hoover, biologist of the New Hampshire State Department of Fish and Game, died at Concord on January 8, after an acute illness of several weeks. Of all the younger workers he showed perhaps the greatest promise of leadership in the impending development of the science and art of fresh-water fish management. Three annual survey reports, the last of which was only recently published, stand as tributes to his energy and competence. He made worth-while contributions to herpetology as well as ichthyology and fisheries science, and was engaged in a brilliant and pioneering research dealing with the effect of altered periods of daylight on the time of reproduction in fishes. An investigation of dwarfing in trout, from the systematic and evolutionary as well as fisheries view-point, was well under way and was to have been utilized for a doctorate dissertation at the University of Michigan.

Hoover was born at Somerset, Pennsylvania, on December 5, 1911. His undergraduate studies were carried on at Lebanon Valley College, and graduate work was done at the Johns Hopkins University, where he served as instructor in 1934–35. Before assuming the position in New Hampshire in 1936, he worked one year as field zoologist in the National Park Service. Despite a tragically short career, Earl Hoover made many friends and a very real impression in several fields of scientific endeavor.

CARL L. HUBBS

RECENT DEATHS

DR. WILLIAM EBENEZER FORD, since 1920 professor of mineralogy at Yale University, with which he had been connected since he graduated in 1899, died on March 23 at the age of sixty-one years.

DR. FRANK NELSON GUILD, professor emeritus, formerly head of the department of geology and mineralogy of the University of Arizona, died on March 12 at the age of sixty-eight years. Dr. Guild had been a member of the faculty of the University of Arizona since 1897.

THE death is announced of Dr. Gustav Hellmann, professor of meteorology at Berlin.

SCIENTIFIC EVENTS

EXCURSIONS AT THE CALIFORNIA MEETING OF THE AMERICAN GEOLOGICAL SOCIETY OF AMERICA

A SUMMER meeting of the Geological Society of America will be held under the auspices of the Cordilleran Section from August 8 to 10 at the University of California at Berkeley. In conjunction with the society there will be meetings of the Paleontological Society, the Seismological Society and the Society of Economic Geology.

An elaborate program of excursions has been arranged. These include three mutually exclusive local excursions to points of interest near San Francisco Bay scheduled for Thursday afternoon, August 10. One excursion will follow the course of the Haywards fault along the front of the Berkeley Hills. This fault is similar to the San Andreas fault in that the chief movement has been horizontal. Distinctive features of the fault will be visited. A second excursion will visit quarries where the Miocene bedded opaline cherts are exposed. A third excursion will visit Hunters Point in San Francisco. Here, Jurassic Franciscan rocks are well exposed.

More extended excursions have been planned to start on Friday, August 11. For these excursions, advance registration is necessary. If an insufficient number of reservations is made for a particular excursion, it will be cancelled. The cost of the proposed excursions can not be quoted at this time, but it is estimated that $5.00 to $6.00 per day should be ample for all expenses exclusive of transportation.

(1) An excursion to Yosemite Valley will illustrate the glacial phenomena of the Sierra Nevada, including the succession of the glacial periods. It is planned to conduct the excursion across the Sierra Nevada to Mono Lake, where the eroded fault scarp of the Sierras may be studied in its relationship to the glacial features.

(2) A second excursion for those interested in metalliferous deposits will include two of the mining districts in the Sierra Nevada and Virginia City.

(3) A third excursion has been planned to Lassen Peak, the source of the volcanic eruptions in 1914–1917.

(4) A series of one-day excursions has been arranged for those interested in paleontology and stratigraphy. With the exception of the excursion to San Francisco and Half Moon Bay, these are all within reach of Berkeley, so that participants in this group of excursions should reserve their rooms in Berkeley to Sunday, August 13. Friday, August 11, will be spent at San Pablo Bay, where Miocene invertebrate fossils can be collected. Saturday, August 12, will be spent collecting Eocene fossils near Martinez. Sunday, August 13, will be spent at the Museum of the California Academy of Sciences, in San Francisco, and participants will drive to Half Moon Bay in the late afternoon. Monday, August 14, will be spent at Half Moon Bay, studying recent organisms. In addition, some of the Tertiary rocks of the San Francisco peninsula will be examined.

(5) If a sufficient number of geologists are interested, an excursion will be arranged for Thursday, August 17, in Los Angeles. Some of the oil fields will be visited, and the Tertiary stratigraphy of the Los Angeles Basin will be examined.

All the excursions are open to fellows and guests;

but those wishing to participate in the post-session excursions are urged to apply not later than May 5.

AWARDS OF THE ALFRED P. SLOAN FOUNDATION

THE Alfred P. Sloan Foundation has made a grant of $25,000 to the Automotive Safety Foundation. With this gift fellowships will be established to give seven state highway engineers and twelve state policemen training at Yale University or Northwestern University for the academic year 1939–40. The awards provide for tuition, living and field expenses.

Twelve Sloan fellows at the Northwestern University Traffic Institute and seven at the Yale Bureau for Street Traffic Research now are completing their courses of study and this year will return to the official positions from which they received leaves of absence. The official announcement reads:

> The fellowship awards have been made available for the second year in the belief that the traffic problem will yield to the broad application of proved techniques and that progress in traffic control will be measurably accelerated when the services of adequate numbers of trained men are made available. Scientific methods and professionally trained personnel have contributed so much to the advancement of the economic value of motor transportation that commensurate relief for the traffic problem through these factors may be confidently anticipated.

The foundation had previously made a grant of $32,500 to the Massachusetts Institute of Technology for the award of fellowships to ten young industrial executives to take up special social and economic training there next June. The awards range from $1,750 for single men to $2,750 for those who are married.

The fellows, who will have a year's leave of absence from their present positions, have been selected on a competitive basis. They are between the ages of 25 and 35 and have had at least five years' industrial experience, part of it in an executive capacity. They are required to be graduates with high academic records in science or engineering of an accredited college or university. Emphasis is placed on managerial ability, seasoned intellectual capacity and a sensitivity to the social and civic implications of industry.

ELECTION OF FELLOWS OF THE ROYAL SOCIETY, LONDON

AT a meeting of the Royal Society held at Burlington House, London, on March 16, the following fellows were elected:

ADAIR, G. S., assistant director of research in physiology, Cambridge, distinguished for his researches on the physical chemistry of proteins, particularly in connection with haemoglobin.

ANDREWES, C. H., pathologist, National Institute for Medical Research, distinguished for his work on filtrable viruses and the bacteriophage, particularly in relation to the neutralization of viruses by antisera, and his studies on filtrable tumors.

BORN, M., *Tait professor of natural philosophy*, University of Edinburgh, distinguished for his work in many branches of mathematical physics and particularly for his contributions to quantum theory and its applications to physics and chemical physics.

BRADLEY, A. J., assistant director of research in crystallography, Cavendish Laboratory, Cambridge, distinguished for his methods of applying x-ray crystallography to elucidate the structure of metals and particularly the gamma phase and order and disorder in alloys.

BRUNT, D., professor of meteorology, Imperial College, London, distinguished for his contributions to analytical and dynamical meteorology, and particularly to the theory of the transfer of heat in the atmosphere.

CREW, F. A. E., Buchanan chair of animal genetics, University of Edinburgh, distinguished for his work on sex reversal in frogs and birds and on the genetics of many animals, especially Drosophila and budgerigars.

EDWARDS, F. W., department of entomology, British Museum, distinguished for his extensive researches on the order Diptera and for his studies on larval characters in relation to classification.

JONES, B. M., Mond professor of aeronautical engineering, Cambridge, distinguished for his researches in aeronautical science and for the elucidation of problems of design, such as the control at slow speeds and the determination of drag on full-scale structures.

KAYE, G. W. C., superintendent, department of physics, National Physical Laboratory, distinguished for his pioneer work in x-ray measurements and for his studies on acoustics and physical constants; has rendered valuable service to the *Radium Protection Committee* and the National Radium Commission.

LIDDELL, E. G. T., fellow of Trinity College, Oxford, distinguished for his researches upon the physiology of muscle movement and posture in mammals, and upon their control during the normal and abnormal functioning of central nervous mechanisms.

MASKELL, E. J., lecturer in plant physiology, Cambridge, distinguished for his work in the realm of plant physiology, especially in relation to problems of translocation.

MASSON, I., vice-chancellor of the University of Sheffield, formerly professor of chemistry, University of Durham, distinguished for his researches in physical chemistry, particularly on the physical interaction of mixed gases and on new aspects of the chemistry of iodine.

MEES, C. E. K., vice-president of the Eastman Kodak Company, Rochester, N. Y., distinguished for his influence on the technology of photography, thereby assisting advance in many branches of science.

NEWMAN, M. H. A., lecturer in mathematics, Cambridge, distinguished for his contributions to pure mathematics, particularly in the field of topology and group theory.

READ, H. H., professor of geology, Imperial College, London, distinguished for original work, especially in connection with the tectonic and petrological problems of the igneous and metamorphic rocks of northern Scotland.

STAPLEDON, SIR R. G., professor of agricultural botany and director of the Welsh Plant Breeding Station, Aberystwyth, distinguished as the founder of the Welsh Plant Breeding Station where, with a team of workers, he has undertaken studies of far-reaching importance on the improvement of pastures.

TURNBULL, H. M., professor of morbid anatomy and director of the Bernhard Baron Institute of Pathology, London Hospital, distinguished for his work on morbid histology, particularly in relation to vascular disease, encephalitis, toxic hepatitis, diseases of bone, and normal and abnormal haemopoiesis.

TURNER, E. E., head of the department of organic chemistry, Bedford College, London, distinguished for his contributions to the stereochemistry of organic compounds, especially in connection with asymmetry in derivatives of diphenyl and with dissymmetry in the phenoxarsines.

WIGGLESWORTH, V. B., reader in medical entomology, London School of Hygiene and Tropical Medicine, distinguished for his researches on insect physiology, especially in relation to digestion, tracheal respiration, excretion and possible endocrine secretion.

WILLIAMS, E. J., professor of physics, University of Wales, Aberystwyth, distinguished for his researches on the passage of electric particles through matter, and on individual collision processes, which have provided evidence for the existence of the heavy electron.

THE ESTABLISHMENT OF AN INSTITUTE OF TECHNOLOGY AT NORTHWESTERN UNIVERSITY

THE trustees of Northwestern University have approved the establishment of an Institute of Technology which is to be conducted on the cooperative basis under which students will spend alternate periods, in school and in industries. This plan was originated by Professor Herman Schneider,[1] of the University of Cincinnati, and has now been adopted in a number of schools.

The institute has been made possible by the offer of the Walter P. Murphy Foundation, an Illinois corporation founded by Walter Patten Murphy, a Chicago manufacturer of railway equipment, to build and equip the unit, the total cost of which will be approximately $6,500,000. It will provide for about eight hundred students in the departments of civil, mechanical, electrical and chemical engineering.

Work on the physical plant will commence immediately. It will house the institute as well as the present departments of physics and chemistry of the university. The new unit will be built at Evanston on the land immediately to the south of the present men's quadrangles. It will have a frontage of approximately five hundred feet along Sheridan Road.

The school will adopt the cooperative plan of engineering education now in operation at several leading engineering schools. It will be conducted in conjunction with the other schools and departments of the university, and will share their present social, academic and research facilities.

It will embrace a research laboratory and, at the outset, four main divisions: civil, mechanical, electrical and chemical. Provision has been made, however, for adding more divisions, particularly those of applied arts, economics, metallurgy and aeronautics. Other departments and bureaus of research will be set up from time to time as deemed advisable to meet educational and engineering needs.

A careful check-system of selecting freshmen will be adopted at the outset, to provide a student body of exceptional intelligence and capabilities. Although entrance requirements will be high, other factors such as aptitude for work, character, resourcefulness, personality, will also bulk large in the selective process.

The courses will be designed so that each student will be provided with the necessary elements of a true liberal education. Training in the arts and social sciences, as well as in mathematics and the basic physical sciences, will be rigorously required.

The students' advisers will have ample time for frequent interviews with each student, to study his development and to help him to solve his problems. Each student will have careful supervision while he is working in industry. Care will be taken not to place too many students in a single firm, in order that they may receive more adequate individual supervision.

Students will be afforded ample opportunities to engage in social, athletic and intellectual activities outside the classroom. They will live in dormitories occupied by students from other schools during the period of work in industry as well as during that spent on the campus.

The progress and expansion of the new school will be subject to close scrutiny, and changes in curriculum and organization will be made slowly as time and differing conditions require.

Dr. Walter Dill Scott, president of the university, has made the following statement:

> Northwestern University and its trustees are exceedingly grateful for this munificent gift and the trust that has been placed with this institution.
>
> The foundation's decision to establish this institute of technology at Northwestern is motivated by a desire to make the greatest possible contribution to the social, industrial and educational advancement of this nation. They have made this decision after a long, exhaustive survey by a corps of men who personally investigated institutions and educational plans from coast to coast before recommending the establishment of the new institute at Northwestern.

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[1] Dr. Schneider died on March 28.

The school's purpose will be to produce men of social vision and sound training, who have a definite understanding of the problems awaiting them in industry and society. This program will be accomplished through joint action with the industries of Chicago and the Midwest in the cooperative plan of education.

I am convinced that this plan—whereby the student works concurrently in industry and in the university—is ideally suited to train engineers. However, though we shall begin work immediately, so that the new school will be ready by next year, the program will be developed gradually, and will always be flexible enough to meet changing conditions.

Not only as president of Northwestern University, but as a citizen of Chicago and Evanston, I rejoice at this great forward step, which I am enabled to announce during my last year as president. I am sure that it will have a profound influence on education and industry in America.

This new school is significant for Chicago because it will enable us to create here one of the world's great centers for engineering education and research. It is significant for industry because it will develop men who, through careful selection and rigid training, offer greatest promise of making contributions to industry and the engineering profession. It is significant for the engineering student because it is designed to furnish a training that will develop him to his maximum possibilities.

That we are exceedingly grateful to the Walter P. Murphy Foundation for having selected Northwestern University as the agent for carrying out this great educational program goes without saying. We pledge the cooperation of every department of the university toward making the new school a great center for engineering training and research.

SCIENTIFIC NOTES AND NEWS

ATTENTION has already been called in SCIENCE to the program of the spring meeting of the American Chemical Society, which will be held in Baltimore from April 3 to 7. Professor Charles A. Kraus, of Brown University, will preside. Dr. J. C. W. Frazer, Baker professor of chemistry at the Johns Hopkins University, is honorary chairman of the meeting, and Dr. John C. Krantz, Jr., professor of pharmacology in the Medical School of the University of Maryland, is general chairman. A general meeting will be held on the afternoon of April 3, at which addresses will be given by Dr. Vincent du Vigneaud, of Cornell University Medical College, on "Isotopes as a Tool in the Study of Intermediary Metabolism" and by Dr. Harold R. Moulton, president of the Brookings Institution, on "The Chemical Industry and the Economic System."

THE Franklin Medal of the Franklin Institute of the State of Pennsylvania has been awarded to Dr. Edwin Powell Hubble, of Mount Wilson Observatory, Pasadena, Calif., and posthumously to Dr. Albert Sauveur, late emeritus professor of metallurgy and metallography of Harvard University. The medal is awarded to Dr. Hubble "in recognition of his extensive study of the nebulae, particularly those outside our galaxy, as a result of which the dimensions of observed space have been greatly increased." The award to the late Dr. Albert Sauveur is made "in recognition of his outstanding work in the science of metallography, and of his many contributions to this branch of metallurgy which have been in a large measure responsible for changing the heat treatment of steel from an art to a science."

THE Western New York Section of the American Chemical Society has announced the award of the Jacob F. Schoellkopf Medal for 1939 to Charles F. Vaughn, of the Mathieson Alkali Works, in recognition of his work "in the graphitization of carbon, his successful development and operation of the Castner mercury cell where all others failed, and his unqualified ability as an executive and administrator, placing him in the front rank of those who have made lasting contributions to the chemical industry."

A DINNER was held on March 28 in honor of Dr. Carl Beck, formerly professor of surgery at the Chicago College of Physicians and Surgeons, now the College of Medicine of the University of Illinois, in recognition of his seventy-fifth birthday and the completion of fifty years in the practice of medicine.

THE twenty-fifth anniversary of Director Frederick M. Gaige as a member of the staff of the Museum of Zoology of the University of Michigan was commemorated by the establishment of the Frederick M. Gaige Research Fund, recently accepted by the regents. The income from this gift, to which more than fifty separate donors have contributed the sum of $1,558, will be used for the promotion or publication of research carried out in the museum.

THE Hallett prize of the Royal College of Surgeons, London, was presented on March 9 to Dr. Alfred McKee Large, of Toronto.

THE Academy of Sciences at Halle has awarded the Carus Medal to Dr. Otto Grosser, professor of anatomy at the German University of Prague. The Forel prize and plaque have been awarded to Dr. Ernst Gabriel, of the University of Vienna.

THE University of Liverpool will confer in May the doctorate of science on Dr. Martin Knudsen, professor of physics in the University of Copenhagen and chief adviser in physical oceanography to the International Council for the Exploration of the Sea.

Mills College conferred on March 16 the doctorate of humane letters on Eve Curie, who is visiting the United States.

The honorary degree of doctor of science will be conferred by the University of Cambridge on Dr. W. N. Haworth, Mason professor of chemistry at the University of Birmingham, and on Sir Henry Dale, director of the British National Institute for Medical Research.

Professor F. G. Donnan, emeritus professor of chemistry of the University of London, has been elected an honorary member of the Société Philomathique of Paris.

It is announced in *Nature* that honorary members of the Royal Meteorological Society have been elected as follows: Jules Jaumotte, director of the Royal Meteorological Institute of Belgium; Dr. Carl-Gustaf Rossby, professor of meteorology at the Massachusetts Institute of Technology, and Philippe Wehrlé, director of the National Meteorological Office of France.

Officers of the Physical Society, London, have been elected as follows: *President,* Professor Allan Ferguson; *Vice-presidents,* Professor G. I. Finch, Dr. Ezer Griffiths, Dr. L. Hartshorn and R. W. Paul; *Honorary secretaries,* J. H. Awbery and Dr. W. Jevons; *Honorary foreign secretary,* Professor O. W. Richardson; *Honorary treasurer,* Dr. C. C. Paterson; *Honorary librarian,* Dr. J. H. Brinkworth.

Dr. Royal N. Chapman, at present director of the experiment station of the Pineapple Producers Cooperative Association, of Honolulu, has been appointed dean of the Graduate School of the University of Minnesota. Dr. Chapman was formerly a member of the faculty at University Farm, where he served as head of the division of entomology and economic zoology, resigning in 1930 to go to Hawaii when the pineapple plantations were threatened with serious insect damage. He succeeds Dr. Guy Stanton Ford, who was dean of the school from 1913 until he was elected president of the university last autumn. During the past two years Dr. W. S. Miller, professor of educational psychology, has been acting graduate dean. Dr. Gerald T. Evans, now assistant professor of biochemistry at Yale University, has been appointed director of the chemical-metabolic laboratories in the Medical School and the University Hospital, with the rank of associate professor of medicine.

Dr. Maxwell Edward Lapham has been elected dean of the School of Medicine of Tulane University. The present dean, Dr. Charles C. Bass, Irby professor of experimental medicine, who began his professional connection with the university in 1904, will reach the retiring age early in 1940, and the work of his office will be taken over by Dr. Lapham at that time.

Dr. Julius M. Rogoff, recently visiting professor of physiology at the University of Chicago and formerly associate professor of experimental medicine at Western Reserve University, has been appointed professor of endocrinology of the School of Medicine of the University of Pittsburgh. A special laboratory has been established and designated as the laboratory of experimental endocrinology, where he will conduct experimental work in this field. The laboratory is supported by the G. N. Stewart Memorial Fund.

Professor Frank Clifford Stockwell, Anson Wood Burchard professor of electrical engineering and head of the department of electrical engineering at the Stevens Institute of Technology, has been appointed dean of the Graduate School, under the new plan of organization of graduate studies which was recently approved by the trustees.

Dr. Carl R. McCrosky has been named chairman of the department of chemistry at Syracuse University, with which he has been associated for twenty years. He succeeds Reginald S. Boehner, who resigned recently because of ill health and who will be on leave of absence for the rest of the year. Dr. Boehner will retain the professorship of organic chemistry.

Dr. Wagner Schlesinger, son of Dr. Frank Schlesinger, director of the Observatory of Yale University, has been appointed director of the Fels Planetarium of the Franklin Institute, Philadelphia. He succeeds Dr. James Stokley, who has been made head of the newly established Buhl Planetarium and Institute of Popular Science in Pittsburgh.

Dr. John S. Hall, of Amherst College Observatory, has been awarded a premium of $500 for his investigations on the velocity of light. This is a portion of the fund established by Uriah A. Boyden, of Boston, in 1859, "to be awarded to any resident of North America who shall determine whether all rays of light and other physical rays are or are not transmitted at the same velocity."

The J. T. Baker Chemical Company research fellowship in analytical chemistry for the Eastern Division has been awarded to Frank K. Pittman, of the Massachusetts Institute of Technology.

Professor Otto Schmidt, the Polar explorer and head of the Soviet Northern Sea Route Administration, has resigned his position to take up work as vice-president of the Academy of Sciences. He is succeeded on the Northern Sea Route Administration by Ivan Papanin, who was a member of the party that spent the winter of 1937–38 on an ice-floe.

THE LONDON *Times* states that the Secretary of State for Air, Sir Kingsley Wood, on the recommendation of the director of Medical Services, Royal Air Force, has appointed the following standing committee to investigate and advise him on the medical aspects of all matters concerning personnel which might affect safety and efficiency in flying: Professor Sir Edward Mellanby, *chairman*, Professor F. C. Bartlett, E. A. Carmichael, C. S. Hallpike, Dr. B. H. C. Matthews, Sir John Parsons, Professor L. J. Witts. The representatives of the Air Ministry on the committee will be Air Vice-Marshal A. V. J. Richardson, director of Medical Services, and Air Commodore H. E. Whittingham.

DR. GEORGE HOYT WHIPPLE, dean and professor of pathology at the School of Medicine and Dentistry of the University of Rochester, will give the Adam M. Miller lecture at the Long Island College of Medicine on April 6. His subject will be "Experimental Anemia and the Building of Hemoglobin in the Body."

UNDER the title "The World's Least Known Tropical Seacoast," Dr. Robert Cushman Murphy, of the American Museum of Natural History, lectured on March 21 before the members of the American Geographical Society on his recent field work along the Pacific coast of Colombia.

DR. LAWRENCE KOLB, assistant surgeon general of the U. S. Public Health Service in charge of mental hygiene, gave on March 1 a lecture on "Drug Addictions" at the School of Medicine of Duke University. On March 8 a motion picture film on industrial accidents and their care was shown by Dr. Henry H. Kessler, specialist in cineplastic surgery.

DR. CHARLES ATWOOD KOFOID, emeritus professor of zoology at the University of California, and Dr. F. W. Went, professor of plant physiology at the California Institute of Technology, were the principal speakers at a biology colloquium held on March 4 at the Oregon State College. The colloquium, which attracted some three hundred scientific men from Oregon and neighboring states, was sponsored by the Oregon State College Chapter of Phi Kappa Phi, the scholastic honor society.

THE School of Medicine of Western Reserve University opened a series of fourteen lectures on "The Social and Economic Aspects of Medicine" on March 17. They will be continued twice weekly until May 9. Besides a number of Cleveland authorities, the speakers will include Dr. Morris Fishbein, editor of the *Journal* of the American Medical Association; Dr. Ralph C. Williams, senior surgeon, U. S. Public Health Service; Dr. Sidney McCurdy, medical supervisor, the Ohio Industrial Commission; Dr. C.-E. A. Winslow, Lauder professor of public health at the School of Medicine of Yale University. The series will be divided into three parts as follows: "A Dynamic Society Encounters Medical Problems," "The Medical Billion and Where It Goes" and "Democracy Feels Its Way."

THE Gehrmann lectures for 1938–1939 of the College of Medicine of the University of Illinois will be delivered in the Medical and Dental College Laboratories building on April 12, 13 and 14 by Dr. Herbert C. Clark, director of the Gorgas Memorial Institute of Tropical and Preventive Medicine of the Panama Canal Zone. The titles of the lectures follow: "Malaria, its Effect on Labor Efficiency in the Tropics"; "Amoebiasis, Clinical and Non-Clinical"; "Modern Factors Favoring Spread of Diseases."

THE Franklin Institute of the State of Pennsylvania will hold an assembly and dinner at the institute on March 31 in honor of the Carbide and Carbon Chemicals Corporation, E. I. du Pont de Nemours and Company, Libbey-Owens-Ford Glass Company, Monsanto Chemical Company and Pittsburgh Plate Glass Company, "for their progressive attitude in carrying on the Benjamin Franklin ideal of the application of science to industry for the benefit of mankind."

THE annual meeting of the French Association for the Advancement of Science will be held at Liège from July 17 to 22, under the presidency of Professor Charles Fabry, director of the Optical Institute, Paris.

ARRANGEMENTS have been made for a joint meeting of the American Meteorological Society and the Royal Meteorological Society of Great Britain at Toronto on August 28 and 29, at which a number of the delegates to the seventh assembly of the International Union of Geodesy and Geophysics will be present. The program will comprise two symposia, one on radiation and the other on extra-tropical cyclones. The meeting will immediately precede a trip which has been arranged by the Travel Committee of the International Union scheduled to leave Kingston, Ontario, on the morning of August 30. Further information will be contained in the forthcoming circular to delegates and guests to be issued early in April.

FOR the Milwaukee meeting the Section on Zoological Sciences (F) of the American Association for the Advancement of Science is planning to hold sessions on June 20, 21 and 22. The sessions on Tuesday will be devoted to an invitation program on "Regeneration," under the chairmanship of Professor J. W. Buchanan, of Northwestern University. On Wednesday another invitation program on genetics will be held under the chairmanship of Professor L. J. Cole, of the University of Wisconsin. The Thursday session will be devoted to a general program of contributed papers. Titles for this session should be sent by April 15 to Dr. George A. Baitsell, secretary of the section, Yale University, New Haven, Connecticut.

SIGMA PI SIGMA, the national physics honor society, will hold its convention on April 6, 7 and 8 at Columbus, Ohio, with the Ohio State University Chapter as host. Delegates from over thirty active chapters will attend the business and scientific sessions, which will conclude with an inspection trip to the Perkins Observatory. Dr. R. C. Colwell, of West Virginia University, the retiring president, will deliver the presidential address on "Electromagnetic Waves and Radio Signals." After being received into honorary membership in the society, Dr. Paul E. Klopsteg, of the Central Scientific Company, will speak at an open meeting on "Archery, a Physicist's Hobby." At a panel discussion, Dr. M. N. States, assisted by Dr. W. P. Davey, Dr. W. E. Forsythe and others, will present various phases of problems dealing with the placement of graduates in physics.

THE Emmons memorial fellowship in economic geology of Columbia University is available for this year with a stipend of $1,200. Applications and accompanying testimonials should be submitted not later than April 15. Applicants should be qualified by training and experience to investigate some problem in economic geology and should submit a definite statement of their problem to the committee, under whose oversight the work will be undertaken at any institution approved by them. The fellow must give his entire time to the problem, which may be used for a doctorate dissertation. Application blanks and further information may be obtained from Alan M. Bateman, Charles P. Berkey, Waldemar Lindgren, or the Secretary, Columbia University, New York, N. Y.

FOUR fellowships have been established at Yenching University by the British Boxer Indemnity Fund for the current academic year. The appointees will serve as research assistants in carrying forward definite research projects. These fellowships are primarily for graduates of Yenching University and carry a stipend of $480 per year. For the current year one appointment has been made in biology, one in physics and two in chemistry.

DR. VLADIMIR NIKOLAEVICH IPATIEFF, since 1930 professor of chemistry at Northwestern University, previously of Moscow and Leningrad, has made a gift of $21,000 to the university for the endowment of a chemical research laboratory for work in high pressures. The new laboratory will be placed in University Hall and will be used for research in chemical synthesis at high pressure. Dr. Ipatieff will be the director of the laboratory.

FORMER GOVERNOR PERCIVAL P. BAXTER has given to the State of Maine 12,000 acres of wild forest land in the Mount Katahdin region to be added to the Baxter State Park. The legislature in 1933 accepted Governor Baxter's first gift of 6,000 acres, which was subsequently named the Baxter State Park.

DISCUSSION

CLIMATE AND REPRODUCTION

WHITAKER'S recent discussion in these columns of the question of seasonal sterility among the Eskimos[1] may be regarded as yet another nail in the coffin of the myth of the human breeding season. The myth is one that dies hard. Westermarck in a discussion of the subject cited some two hundred references in support of the theory that the ancestors of modern man were characterized by a circumscribed pairing or breeding season.[2] The notion that the periods at which the greatest number of births occur among the human species indicate the survival of a primitive human sexual rhythm associated with "annual changes in the human organism especially connected with the sex function" was discussed very fully by Havelock Ellis many years ago.[3] These ideas find a place in the works of such distinguished physiologists as Marshall[4] and Wright,[5] and they have found a vigorous supporter in a leading student of population.[6]

Such authors have assumed that, since the catarrhine monkeys and the anthropoids are characterized by a pairing season, the ancestors of modern man must likewise have been so characterized and that certain primitive peoples still exhibit evidences of this "ancestral trait." It so happens that the major premise of this syllogism is a pure assumption without the slightest factual foundation, for the evidence is quite clear and definite that neither the catarrhine monkeys nor the anthropoid apes are characterized by a breeding season, but on the other hand that they are capable of breeding and of copulating at all times.[7] The statements of travelers and of other occasional observers concerning the existence of an alleged breeding or rutting season among certain primitive peoples could be quoted *ad nauseam,* but there is one that has been so often quoted by those who have put their faith in a human breeding season, and which is so typical of all such statements, that it deserves to be given here together with the sort of evidence which puts such statements in the category to which they properly belong. Westermarck[8] begins his citation of the evidence in support of the existence of a breeding season in primeval man with the statement that "According to Mr. Johnston, the wild Indians of California, belonging to the lowest races on earth, have their rutting seasons as regularly as have the deer, the elk, the antelope, or any other animals.[9] With reference to some of these Indians, Mr. Powers says that spring 'is a literal Saint Valentine's Day with them, as with the natural birds and beasts of the forest.'"[10] When we consult our greatest authority on the California Indians for some light on these matters we find him writing of the Yurok, a Californian people who live along the reaches of the lower Klamath River, that they are characterized by an excessive desire for wealth and the great regard in which they hold money, which circulates among them in the form of dentalium shells.

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[1] W. L. Whitaker, SCIENCE, 88: 214, 1938.

[2] E. Westermarck, "The History of Human Marriage," Vol. II, p. 76, 1922; "The Future of Human Marriage," p. 10, 1936.

[3] H. Ellis, "Studies in the Psychology of Sex," Vol. II, p. 88, 1900.

[4] F. H. A. Marshall, "The Physiology of Reproduction," p. 672, 1910.

[5] S. Wright, "Applied Physiology," p. 198, 1934.

[6] A. M. Carr-Saunders, "The Population Problem," p. 92, 1922.

[7] For a discussion of the evidence which it is impossible

> The significant fact is that they hold a strong conviction that the dentalium money and the congress of the sexes stand in a relation of inherent antithesis. This is one reason given for the summer mating season: the shells would leave the house in which conjugal desires were satisfied, and it is too cold and rainy to sleep outdoors in winter. . . . Births occurred among the Yurok and their neighbors chiefly in spring. This was, of course, not because of any animal-like impulse to rut in a certain season, as has sometimes been imagined, but because of highly specialized ideas of property and magic. . . . Since dentalia and other valuables were kept in the house, a man never slept there with his wife. . . . The institution of the sweat house rendered this easily possible. In summer, however, when the cold rains were over, the couple made their bed outdoors; with the result that it seems natural to the Yurok that children should be born in spring.[11]

Thus, when the superficial observations of the older observers are interpreted in the light of the facts they are seen to have a meaning quite different from that which has rather loosely been attributed to them.

In recent years, as a result chiefly of Rowan's work[12] on artificial illumination and sexual periodicity,[13] an attempt has been made to bolster up the breeding season myth in the special case of the Eskimo.[14] Whitaker has shown the unsatisfactory nature of the evidence upon which this attempt was based. In passing it may be remarked here that Rowan's work has been very generally misunderstood as proving that light *qua* light is the causative factor in producing gonadal development, whereas what Rowan has actually claimed to have shown is that it is more probably the effect of light, namely, *wakefulness,* which produces the observed effect.[15]

Now, while it is certain that no human beings are characterized by a circumscribed period of reproduction, there exists a certain amount of evidence which very strongly suggests that climatic factors do affect the reproductive capacity of most vertebrates, including man. Thus, for example, the breeding seasons of various birds and mammals can be shown to be correlated with certain seasons, and when these animals are removed from the Northern to the Southern Hemisphere, or *vice versa,* they adapt themselves after a short time to the reversed calendric seasons and come into oestrus in the season in which they formerly did, although in different months. This has been shown in the case of birds,[16] and for the mammals thus far investigated.[17] For the distribution in the incidence of conceptions in the primates with a high relative sterility and menstrual disturbance in the summer months this seasonal correlation has been shown to hold good in the case of the rhesus monkey,[18] and also for man.[19] The high frequency of disturbances of the menstrual cycle during the summer months in young and adult women has been reported by many investigators,[20] and it is also of some interest to note that

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to cite here see M. F. Ashley-Montagu, "Coming into Being Among the Australian Aborigines," p. 258, 1937.

[8] *Loc. cit.*, p. 81.

[9] A. Johnston, "The California Indians," in H. R. Schoolcraft, "Historical and Statistical Information respecting the History, Condition, and Prospects of the Indian Tribes of the United States," Vol. IV, p. 224, 1860.

[10] S. Powers, "Tribes of California," in "Survey of the Rocky Mountain Region," p. 206, 1877.

[11] A. L. Kroeber, "Handbook of the Indians of California," *Bureau of American Ethnology Bulletin,* Vol. 78, 41, 1925.

[12] W. Rowan, *Nature,* 115: 494, 1925; *Nature,* 120: 11, 1928; *Proc. Bost. Soc. Nat. History,* 38: 147, 1926; *Proc. Bost. Soc. Nat. History,* 39: 151, 1929.

[13] For a review of the literature dealing with this subject see T. H. Bissonnette, *Quart. Rev. Biol.,* 11: 371, 1936, and Rowan's forthcoming paper, "Light and Reproduction," *Biol. Rev.,* 13: 374, 1938.

[14] Ll. J. Llewellyn, *Nature,* 129: 868, 1932.

[15] W. Rowan, *Proc. Zool. Soc. London,* Ser. A, 108, Pt. 1: 51, 1938.

[16] J. R. Baker and R. M. Ranson, *Proc. Zool. Soc. London,* Ser. A. 108, Pt. 1, 101, 1938.

[17] F. H. A. Marshall, *Proc. Roy. Soc.,* 122 B: 413, 1937.

[18] C. G. Hartman, *Contrib. Embryol.* No. 134: 39, 1932.

[19] C. A. Mills and F. A. Senior, *Arch. Int. Med.,* 46: 921, 1930.

[20] E. T. Engle and M. C. Shelesnyak, *Human Biol.,* 6: 431, 1934; E. Allen, *Am. Jour. Obst. and Gynec.,* 25: 705, 1933; C. F. Fluhman, *Am. Jour. Obst. and Gynec.,* 26: 642, 1933; J. L. King, *Am. Jour. Obst. and Gynec.,* 25: 583, 1933.

the greatest number of abortions appears to occur during the summer months.[21]

Apart from the evidence provided by the lower vertebrates, the fact that the lowest number of conceptions, the greatest number of menstrual irregularities and the greatest number of abortions occur in the human species wherever investigated during the summer months indicates that the reproductive life of man is in some way influenced by climatic factors. That these factors are probably fairly complex should, for methodological purposes at least, be assumed, for it now seems unlikely that any one single factor such as light or temperature alone can be considered as the sufficient cause of these reproductive phenomena. The low summer conception rates among the Eskimo of Greenland as given by Bertelsen[22] and referred to by Whitaker is yet another illustration of this apparently universal relation between low reproductivity and the summer months. What the nature of this relation is here, as elsewhere, is a problem which remains to be investigated. The purpose of the present communication is to make it clear that such a relation exists.

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VITAMIN B_1 IN SOIL[1]

Williams and Spies[2] have advanced the theory that thiamin (vitamin B_1) may be present in soils. Since certain thiamin-requiring fungi are able to detect minute quantities of this substance (0.05 micrograms per liter), the writers undertook to test this theory. Duplicate soil samples were obtained from two different localities in the vicinity of Morgantown, W. Va. The first was taken from a cultivated field, and the second from a sharply sloping and sparsely wooded tract that has never been under cultivation. The soil sampler was driven to a depth of 4 feet and cores of soil one inch in diameter and 48 inches long were secured. The cores were divided into 4 one-foot lengths and separately extracted with pyridine water (3:1) for 5 hours on a steam bath. The extract was filtered off, taken to dryness under reduced pressure, repeatedly dissolved in water and dried until all traces of pyridine disappeared, and the pyridine-free extract was added to the basic medium containing the essential mineral salts, amino acids and dextrose. One half of the extract from each sample of soil was added to 50 ml of the nutrient medium, solidified with 2 per cent. purified Bacto agar, poured in test-tubes, sterilized and inoculated with the test organisms. The other half of the extract was tested without the addition of agar. The following organisms were used: (a), *Phytophthora erythroseptica,* a fungus that requires thiamin for its growth; (b), *Phycomyces blakesleeanus,* capable of growing in the presence of either thiamin or a mixture of the two moieties of thiamin—thiazole and pyrimidine; (c), *Pythiomorpha gonapodioides,* which grows equally well in the presence of either thiamin or pyrimidine only; (d), *Mucor ramannianus,* capable of making equally good growth in the presence of thiamin or thiazole alone, and (e), *Sordaria fimicola,* which does not grow in the presence of thiamin or its moieties alone, but must have one of the bioses—biotin. The control medium failed to induce growth in any of the foregoing organisms, while all five fungi flourished in both solid and liquid media containing soil extract. The extract from the surface foot of soil induced a better growth than that from the lower ones, but even the fourth foot of soil contained enough thiamin to induce fair to good growth.

Cores of soils taken at a depth of 8 feet from a pasture land showed that the soil contained enough pyrimidine seven feet under the surface, where the microflora is very sparse, to induce a rich growth in pyrimidine-requiring organisms; enough thiazole to induce a fairly good growth in *Mucor ramannianus,* and sufficient thiamin to promote some growth in *Phytophthora erythroseptica.* This shows that not all the thiamin or its moieties found in the soil remain associated with living organisms but that some may leach into the clay and remain adsorbed on the particles.

Robbins[3] and White[4] have shown that thiamin is essential for the cultivation of excised roots of tomato, while Bonner[5] has found that in certain plants root formation is induced only when thiamin is added to the rooting medium. Biotin is essential for numerous microorganisms, and since it is present in many plant and animal tissues, eventually it may be found to be of considerable importance in the biological processes. It may be possible that the presence of thiamin and biotin in soils will give added significance to the role of organic matter in soil fertility.

Virgil Greene Lilly
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PRESERVING THE VIABILITY OF BERMUDA ONION SEED

It is well known that many seeds retain their viability for a comparatively short time, especially in a moist warm climate. Bermuda onion seed, which is used largely in our southern states, often gives trouble from low germination, even when the seed is not more than a year old.

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[21] W. Millar, *Human Biol.,* 6: 279, 1934.

[22] A. Bertelsen, *Meddelelser om Grønland,* 117: No. 1, 1935.

[1] Published with the approval of the director of the West Virginia Agricultural Experiment Station as Scientific Paper No. 216.

[2] Williams and Spies, "Vitamin B_1," p. 381. Macmillan Company, New York, 1938.

[3] Robbins and Bartley, Science, 85: 246–247, 1937.

[4] White, *Plant Physiol.,* 12: 803–811, 1937.

[5] Bonner, paper read at Richmond meeting of A.A.A.S., 1938.

Samples from a number of lots of Bermuda onion seed imported from the Canary Islands were combined and dried at a low temperature in a partial vacuum to 6.4 per cent. moisture content in November, 1924. Portions of this seed were stored (*a*) in paper packets at room temperature in the laboratory, and (*b*) sealed in air-tight containers and stored part at room temperature in the laboratory and part in a cool chamber at a temperature ranging from 5° C. to 10° C.

The seed has been tested from time to time, with the results given in Table 1.

TABLE 1
GERMINATION OF BERMUDA ONION SEED AFTER STORAGE

Length of storage	Germination after storage in		
	Paper packet in room, per cent.	Sealed tube in room, per cent.	Sealed tube in cold chamber, per cent.
Check test	94	94	94
16 months	83	88	89
3 years	36	94	93
7 years	0	89	91
11 years	..	89	87
13 years	..	90	89

This small experiment illustrates strikingly the importance of maintaining a low moisture content in stored seeds if vitality is to be preserved.

In plant breeding work, it is important to maintain original stocks of seed over long periods for purposes of comparison. This is especially important in the case of annuals and biennials. It is entirely feasible to artificially dry small lots of seed and store them in air-tight containers to preserve their viability for relatively long periods. A like procedure is practical for the storage of commercial seeds of valuable strains.

EDGAR BROWN

BUREAU OF PLANT INDUSTRY,
U. S. DEPARTMENT OF AGRICULTURE

BACTERIA OF THE LISTERELLA GROUP ISOLATED FROM FOXES

THE recent report of Graham and his associates[1] on Listerellosis of cattle and sheep in Illinois has redirected our attention to an organism isolated in early June, 1937, from silver foxes from a nearby fur farm. The disease, which spread rapidly through the sheds, killing a considerable number of the young animals, was pronounced distemper by a prominent authority on fox diseases called into consultation by the attending veterinarian.

We did not learn much about the symptoms except that the animals became prostrate and were dead a few hours later. Examination of the internal organs revealed no significant changes. Heart's blood cultures from eight of the animals were made to beef heart infusion broth, and from five of them the cultures were positive. One of the positive cultures was from a very sick fox pup which was killed and the culture made immediately afterward. The organism, which was the same in all the cultures, is a slender gram positive even-staining rod in broth culture. Films made from blood agar slants show a gram positive rod similar in size, shape and arrangement to *Corynebacterium hoffmanni.* It is sluggishly motile. Doses of 0.5 cc of a 24-hour broth culture injected into each of two 400-gram guinea pigs proved fatal in two days with recovery of the organism from the heart's blood. Mice also proved susceptible.

The organism was considered to belong probably to the Listerella group. Dr. Graham has very kindly examined the culture and tentatively identified it as a "Listerella or Listerella-like type."

We have no evidence of etiological connection of this organism with this outbreak of disease among the foxes. We feel, however, that it must have had some significance, either as a primary or a secondary factor in the illness of those animals from which it was isolated.

H. W. CROMWELL
E. E. SWEEBE
T. C. CAMP

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THE ANTI-MENORRHAGIC FACTOR OF MAMMALIAN LIVER FAT

FOLLOWING the introduction of oral liver extracts for the treatment of anemia it was observed by some physicians that some of these preparations were useful in controlling some cases of functional uterine bleeding (menstrual bleeding of prolonged or profuse nature, not due to benign or malignant tumors). Although the original purpose of the liver therapy was to treat the secondary anemia following this bleeding, there was often noted a diminution or cessation of the abnormal hemorrhage itself, even though the blood count was unaffected. This property was found in the cruder preparations but not in the highly purified oral or parenteral solutions. Since this purification involves no treatment likely to inactivate any constituent, the fraction in question was probably removed in the process. Inactive proteins and lipoids constitute much of the material removed in the purification of parenteral solutions.

Since 1936 we have been investigating the lipoid fraction of mammalian liver. Saponification of beef or hog liver fat in hot alcoholic potash for one hour yielded an orange-colored, non-saponifiable residue, which was tested on patients suffering from functional uterine bleeding. The administration by mouth of an adequate dosage completely controls the menorrhagia or metrorrhagia. Thus far our clinical observations indicate that in young women there is a cumulative effect lasting for months after its administration has been discontinued. Patients in the latter part of menopause who suffer from menorrhagia or metrorrhagia require much larger doses than the former group and show no cumulative effect, requiring treatment with each period. This apparent inverse dosage with the ovarian function suggests that its action is related to the functional activities of the gonads. Curtis[1] also has reported favorable results from the use of liver extract and of our fraction.

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[1] SCIENCE, August 19, 1938, page 171.

While it was known from the work of Dam[2] that liver fat contains the anti-hemorrhagic vitamin K, we did not consider the anti-menorrhagic factor to be related, since it withstands hot saponification. The recently reported observations of Lichtman and Chambers[3] indicate that there is a saponification-stable substance in liver fat which has some of the properties of vitamin K.

We are continuing the fractionation and testing of the anti-menorrhagic factor (produced commercially as "Anti-menorrhagic Factor"—Armour) and have begun experiments to determine the identity or non-identity of the anti-hemorrhagic and anti-menorrhagic factors.

HAROLD O. WILES
SIEGFRIED MAURER
OTHO S. A. SPRAGUE MEMORIAL INSTITUTE AND
DEPARTMENT OF PATHOLOGY, UNIVERSITY OF CHICAGO

SCIENTIFIC BOOKS

RECENT BOTANICAL BOOKS

Economic Botany: A Textbook of Useful Plants and Plant Products. By ALBERT F. HILL. vii + 592 pp. 225 figs. McGraw-Hill Book Company, Inc., New York. 1937. $4.00.

THE author states that this book is the "outgrowth of several years' experience in presenting a one-semester course dealing with economic plants." He has expressed an aim to give the student, through a knowledge of industrial, medicinal and edible plants, a broader outlook, greater interests in the world about him and a realization of the importance of plants and plant products to mankind. Nine chapters deal with such industrial plants and plant products as fibers, wood, cork, tanning and dye materials, rubber and other latex products, gums and resins, essential oils, fatty oils and waxes and sugars, starches and cellulose products. Two chapters consider medicinal plants, fumitories and masticatories. Seven chapters discuss the history and nature of food plants, cereals, legumes and nuts, vegetables and fruits, both of temperate and tropical regions. There are two chapters on food adjuncts, including spices and other flavoring materials, beverage plants and beverages. A systematic list of species discussed, a bibliography and an index constitute the appendix. Books of this sort serve a good purpose, and the author has succeeded well in carrying out the aims expressed in the preface.

W. W. ROBBINS

UNIVERSITY OF CALIFORNIA

Herbals, Their Origin and Evolution. A chapter in the history of botany, 1470–1670. By AGNES ARBER. 2nd ed. xxiv + 326 pp. 131 figs. 26 plates. Cambridge University Press, Cambridge. 1938. $7.50.

THE revival of interest in herbs and herb gardens makes unusually timely this revised and enlarged edition of Mrs. Arber's book on herbals. These curious mixtures of descriptive botany, gardening, folk-lore, medicine, wood-engraving and even cookery were so highly prized in families fortunate enough to own one that many have come down in good condition to the present time and formerly could be bought at reasonable prices. Their acquisition by institutions and private collectors has made prices soar, and good copies of the classic herbalists have become impossible except to the very wealthy.

Mrs. Arber's book offers more, however, than could be found in any one collection, since it contains excellent reproductions of the more striking of the drawings and woodcuts from a variety of sources, many inaccessible to the ordinary botanist. While nearly all the text figures and plates of the earlier edition have been retained, a few substitutions have been made, and the number has been increased. Much of the text has been rewritten and expanded. An appendix lists chronologically the more important herbals and botanical works published during the period covered.

Even libraries and individuals owning a number of herbals will find in this book valuable sidelights on the development of descriptive botany in the comparative chapters on the various countries and in the attractive and accurate accounts of the herbalists themselves.

B. F. LUTMAN

UNIVERSITY OF VERMONT

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[1] A. H. Curtis, "Textbook of Gynecology," pp. 111, 404. W. B. Saunders Company, 1938.

[2] H. Dam and F. Schonheyder, *Biochem. Jour.*, 30: 897, 1936.

[3] A. L. Lichtman and W. H. Chambers, SCIENCE, 88: 358, 1938.

Introduction to Plant Pathology. By Frederick DeForest Heald. xi + 579 pp. 200 figs. McGraw-Hill Book Company, New York and London. 1937. $4.00.

Dr. Heald would be the first to insist that there is little point in a review which is wholly laudatory, or merely descriptive, yet I am unable to write any other sort regarding his latest book. This volume is the work of a master of lucid style with long experience in preparing texts, who is recognized as one of the best teachers of plant pathology in this country.

Diseases caused by parasites still get the largest share of space, a little more than 250 pages. The nonparasitic and virus diseases take up about 150. The sixty pages given to plant disease prevention and control include a number of recently discovered and little known methods, while the fifty introductory pages give material of general and vital interest to students who are not specifically interested in agriculture or, for that matter, in plant pathology, but merely in human affairs. If forced to indicate a change, I would suggest the omission of the section on "Methods," leaving that subject for the more detailed manuals.

Teachers of plant pathology are fortunate to have such a book available, and I suspect there are few of them who do not frequently consult it, even if they do not use it in their classes.

Neil E. Stevens

University of Illinois

Plant Ecology. By John E. Weaver and Frederic E. Clements. Second edition. xxii + 601 pp. 271 figs. McGraw-Hill Book Company, New York and London. 1938. $5.00.

The first edition of this book appeared in 1929. The second revised and enlarged edition appears while the work is still unrivaled in our language. The new edition has 81 more pages, 9 more illustrations and 429 more papers cited in its literature list than the old.

Considerable attention is given to applied ecology, notably conservation. Much new and valuable material is included under the discussion of soil. However, recent advances in the field of atmospheric factors and climatology have received less attention than they deserve. The section on methods of studying vegetation has been augmented somewhat. Without enthusiasm, the frequency-abundance quadrat method is described. Besides other variations of the quadrat, the relict method and pollen analysis also are discussed.

The past decade has seen remarkable advance in the practical use of ecology. In education the condition is less satisfactory. In many of the leading older institutions the subject is not recognized as a discipline nor given attention in introductory biology. Perhaps matters would be helped if such an influential book as this were to approach the difficult problem of vegetation and plant communities in a more tentative spirit. The task of reducing this problem to some order has involved drastic measures which create the impression of a finality that is doubtless far from the thoughts of either author.

Paul B. Sears

Oberlin College

Plant Physiology. With reference to the green plant. By Edwin C. Miller. Second edition. xxxi + 1201 pp. 39 figs. McGraw-Hill Book Company, New York and London. 1938. $7.50.

Although the chapter headings are the same as in the first edition, much new material has been incorporated. The increase in length is 300 pages, and of these 61 have been added to the chapter on growth; about 20 pages each to the chapters on the cell, loss of water, formation of carbohydrates, nitrogen metabolism, translocation and respiration; less than 10 pages of increase are found in each of the chapters on solutions and membranes, intake of water and solutes, fat metabolism and digestion. The large number of literature references which made the first edition so valuable to teachers, students and those engaged primarily in research work has been doubled in the new edition, so that now approximately 6,500 citations are available. The extraordinary interest in recent years in the subject of growth is shown by the fact that the 250 references that sufficed for the first edition (literature up to 1929-30) have been increased in this edition to approximately 900. New material, or more complete discussions than appeared in the previous edition, will be found on the following topics: cell membrane formation, oxygen supply and root growth, absorption of solutes, minor elements, indications of nutrient deficiencies, drought resistance, autumnal coloration, nitrogen metabolism, latex, cohesion theory of the ascent of sap, translocation (direction, distance, mechanism, tissues involved), respiratory coefficients, composition of air of intercellular spaces, growth-promoting and growth-inhibiting substances, dormancy, ripening, radiation (wave-lengths, x-rays, polarized light), photoperiodism, bioelectric phenomena, effects of various gases and vernalization.

F. E. Denny

Boyce Thompson Institute
for Plant Research

The Structure and Development of the Fungi. By H. C. I. Gwynne-Vaughan and B. Barnes. xvi + 449 pp. 309 figs. Second and revised edition. The University Press, Cambridge. 1937. $5.50.

The first 48 pages deal with the general characters of the fungi, such as structure, physiology and relationships to other organisms. This introductory survey is the most interesting and valuable part of the book, bringing to one's attention much important work that has been omitted from other similar books. A brief discussion of the Monads, the possible representatives of the ancestral stock of the fungi, is given. The Myxomycetes and Plasmodiophorales are excluded from the fungi and are unfortunately too briefly discussed.

Then follows a morphological and cytological discussion of the fungi from the Phycomycetes through the Basidiomycetes. The Fungi Imperfecti are dismissed in two pages. The final chapter of twenty pages is on mycological technique, presenting valuable information on the isolation, culturing and staining of fungi. The list of literature includes well over 1,000 titles.

The authors have the knack of saying much in a few words, and it is therefore unfortunate that so many valuable investigations, instead of being summarized, are passed over entirely or merely mentioned. For example, in the preface the authors emphasize the importance of flagellation as a guide to the interrelationships of the Phycomycetes and yet fail to take full advantage of both old and new researches on this very subject.

It must be remembered, however, that the book is addressed to the student rather than to the investigator, and as such a book it will fill an important need in mycology classes.

JOHN N. COUCH

UNIVERSITY OF NORTH CAROLINA

The Structure of Economic Plants. By HERMAN E. HAYWARD. x + 674 pp. 340 figs. The Macmillan Company, New York. 1938. $4.90.

THIS book, "an outgrowth of courses in plant anatomy offered at the University of Chicago since 1927," is most timely and welcome. For a long time those interested in applied botany, research workers and students, have had a need for a work which would assemble the investigations relating to the structure and developmental anatomy of important economic plants. This work may serve to point out that the student may learn fundamental anatomy from a consideration of such plants as onion or radish as well as from a study of little-known and relatively unimportant species.

The book is organized in two parts, the first of four chapters dealing with general plant anatomy, the second with the structure of a selected number of economic plants. Part I, including cells and tissues and their development, the anatomy of the root, the anatomy of the shoot and the anatomy of the flower and fruit, is sufficiently comprehensive to make the book generally useful.

Part II considers the structure and developmental anatomy of *Zea mays, Triticum* spp., *Allium cepa, Cannabis sativa, Beta vulgaris, Raphanus sativus, Medicago sativa, Pisum sativum, Linum usitatissimum, Gossypium* spp., *Apium graveolens, Ipomoea batatus, Solanum tuberosum, Lycopersicum esculentum, Cucurbita* spp. and *Lactuca sativa.* The author states that "the principal criteria determining the selection were the economic importance of the plant, its suitability as a representative of the family to which it belongs, and the intricacy of its anatomical and morphological detail." In addition to the numerous original illustrations, others have been selected from various special studies; nearly all are well-labelled. Citations of the more important literature conclude each chapter. A glossary "defining the terms in the sense in which they are used in this work" is appended. It is gratifying to know that the author contemplates a second volume which will deal more especially with important fruit crops. The present volume is a distinct contribution, meeting a long-felt need in the field of applied botany.

W. W. ROBBINS

UNIVERSITY OF CALIFORNIA

General Plant Physiology. By E. C. BARTON WRIGHT. Foreword by Sir F. Gowland Hopkins. 539 pages, 44 figs. P. Blakiston's Sons and Company, Philadelphia. 1938. $4.50.

THE reviewer considers this book to be one of the better texts in plant physiology. Conservative in the treatment of many topics, the emphasis on the various aspects of plant physiology is well placed, and the student who masters such a presentation will receive sound training upon which to evaluate more controversial work. The chemical aspects of physiology receive the greater attention; the discussions of carbohydrates and fats are especially well done. Preliminary training in organic chemistry is a necessary prerequisite for an understanding of a large part of the material discussed. Effective use is made of curves, diagrams and structural formulae.

There is a tendency to give greater prominence to English contributors to plant physiology, as might be expected, and not every one would agree with the author's judgment that Mason and Maskell's and Mason and Phillis' studies on translocation in the cotton plant "represent . . . one of the most brilliant series of advances that has been made in plant physiology," in spite of the extensive and thorough work involved in those studies. Some will object also to statements that all living things are capable of movement, that metabolism is the main concern of plant physiology, and some will criticize the emphasis placed on the gas exchange in respiration rather than the energy relations. Others will be disappointed to find that vapor pressure receives little attention in the consideration of transpiration. To still others, however, it will be a pleasure to find that osmosis is treated as diffusion through a membrane and that it is not limited to the diffusion of water through a semi-permeable membrane, as some American authors are inclined to treat it. The book is divided into three parts—Part I, "General Physiology of the Cell"; Part II, "Metabolism"; and Part III, "Growth, Reproduction and Irritability." That such a division is not entirely satisfactory is shown by the inclusion of transpiration and ascent of sap in Part I, "General Physiology of the Cell," and transport of solutes in Part II, "Metabolism."

A few criticisms selected from many pages may give an impression that much of the book is regarded unfavorably. Such is not the intent, however, as is indicated by the early portion of this review.

The press work and binding are excellent.

WILLIAM J. ROBBINS

NEW YORK BOTANICAL GARDEN

A Bibliography of Eastern Asiatic Botany. By ELMER D. MERRILL and EGBERT H. WALKER xlii + 719 pp. Jamaica Plain: Arnold Arboretum. 1938. $12.50.

IN every field, good bibliographies are keys to literature that vastly enhance its usefulness. Perhaps the time may come when the best bibliographies will cover the fields where such works are most needed, but up to the present time most bibliographers have chosen their own fields, and each has recorded the literature of the subjects in which he was most deeply interested.

And so it has happened that this fine bibliography, remarkably complete and accurately compiled, deals with the plant life of eastern Asia, with which both authors have long concerned themselves. It may be said in justification of this undertaking that, unless checked by the present unsettled conditions in that part of the world, our knowledge of the Asiatic flora is entering upon an era of great expansion, and the existence of a record such as this of what has already been done may prevent duplication of effort.

"Eastern Asia," as the term is here used, "comprises China, Japan, Formosa, Korea, Manchuria, Mongolia, Tibet, and eastern and southern Siberia," and works are included relating to the flora of adjacent regions, when these have an important bearing on that of the region mentioned. There are more than 21,000 author-entries, including references to more than 1,200 serials; these have been checked to the original sources whenever possible, and an effort has been made to correct erroneous statements of dates of publication, unless this would involve unwarrantably extensive investigation. The troublesome cases arising from the many authors' names and the titles in Russian, Japanese and Chinese characters have been handled in an eminently satisfactory manner, and there are separate lists of Chinese and Japanese serials and of Chinese and Japanese authors. There are also classified subject-indexes, filling about 125 of the quarto pages. The clerical and typographical errors are remarkably few for a work of this character. In short, the volume is a permanent testimonial to the diligence and scholarship of its authors and will long remain a standard work of bibliographic reference.

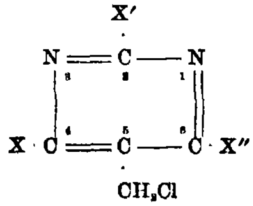
JOHN H. BARNHART

NEW YORK BOTANICAL GARDEN

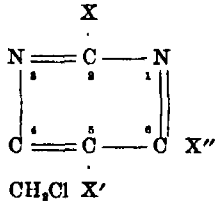
SPECIAL ARTICLES

VITAMIN RESEARCH

A BIOCHEMICAL research program that is receiving attention in the Sterling Chemistry Laboratory at the present time calls for the development of practical methods of synthesizing primary halides of the pyrimidine type, corresponding to the organic structure expressed by formula I. Primary, pyrimidine halides of such constitution are difficult to prepare, and function as necessary intermediates in the synthesis of vitamin principles of the vitamin B_1 type. For example, the recently devised method of synthesizing the antineuritic vitamin, *thiamin* (V), is based on the fact that a pyrimidine halide represented by formula III couples



I



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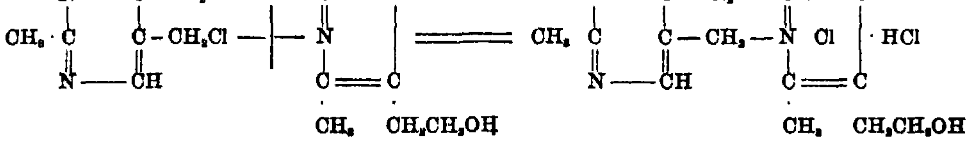
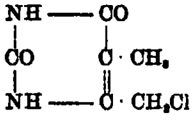
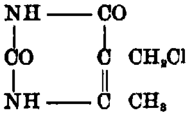


III IV V



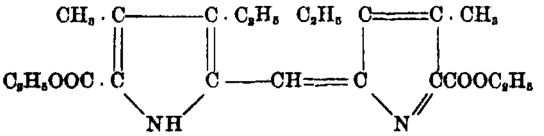
VI



VII

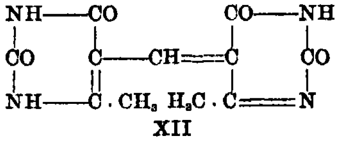
with a specific thiazole (IV) to form the naturally occurring quaternary salt (vitamin B_1) V.[1]

In carrying forward this research program to date our efforts have been confined to the development of new methods of synthesis and to the study of the chemical properties of pyrimidine halides of the uracil type. We now desire to report a recent discovery which reveals a striking difference in chemical behavior between the two isomeric pyrimidine halides expressed by formulas VI and VII. Here we are dealing with primary halide groupings substituted in the 4- and 5-positions, respectively, of the 2,6-dioxy-pyrimidine molecule.



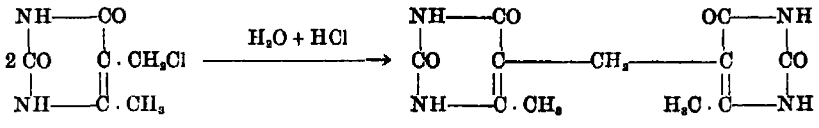
XI

It was the senior author's experience during his earlier researches on the synthesis of simple nucleoside constructions in 1913–1915 that pyrimidine halides of the type VI are extremely stable and are very resistant to hydrolysis. For example, it was shown that both 4-chloromethyluracil and the pyrimidine halide VI can be heated with concentrated hydrochloric acid at 125–130 without alteration.[2] This behavior is in marked contrast to that observed with the halide represented by formula VII.

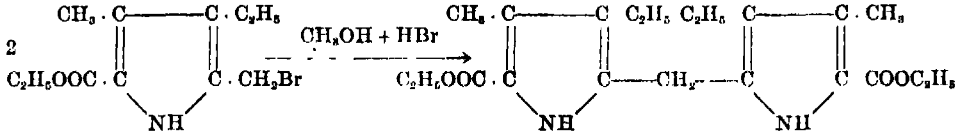


XII

This pyrimidine VII is very unstable when digested with alcohol or water and can be converted practically quantitatively into the dipyrimidine methane derivative VIII upon treatment with hydrochloric acid. This unexpected change is quite analogous to the well-known pyrrol reaction applied successfully by Professor Hans Fischer and his coworkers in many cases for the preparation of dipyrrol methanes; and which is illustrated by the following reaction employed for the preparation of the dipyrrol methane derivative X.[3] These dipyrrol methane compounds such as X easily undergo oxidation to the corresponding dipyrrol methenes XI.



VII VIII



IX X

Whether our dipyrimidine methane compounds such as VIII may be oxidized to the corresponding unknown dipyrimidine methene derivatives such as XII remains to be determined.

A complete account of the results of this pyrimidine investigation will be presented in future publications from this laboratory.

TREAT B. JOHNSON
MARGARET M. ENDICOTT
YALE UNIVERSITY

THE PREPARATION OF GLUTATHIONE CONTAINING RADIOACTIVE SULFUR

ARTIFICIAL radioactive elements are usually produced as the free isotopes of ordinary elements and may be used in the preparation of compounds suitable for study. The present work was undertaken in order to find a method of obtaining radioactive glutathione to be used later in the study of certain phases of sulfur metabolism in rats. Briefly, this method consisted in growing yeast in a medium containing radioactive sulfur in a form which was easily assimilated by the yeast in its growth. Subsequently glutathione was extracted from the yeast so obtained and found to be radioactive. The technique developed is probably applicable to the preparation of other compounds.

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[1] Williams and Cline, *Jour. Am. Chem. Soc.*, 58: 1063, 1504, 1936; 59: 216, 1937; Cline, Williams and Finkelstein, 59: 1052, 1937.

[2] Johnson and Chernoff, *Jour. Am. Chem. Soc.*, 36: 1742, 1914; 35: 585, 1913; *J. Biol. Chem.*, 14: 307, 1913.

[3] Fischer *et al.*, Ann. 447: 137, 1926; 448: 199, 1926; 459: 85, 1927; 486: 39, 1931; and several other publications.

The strain of yeast used was *Saccharomyces cerevisiae,* Frohberg type,[1] which was known to produce considerable quantities of glutathione. The medium used was an adaptation of that employed by Sugata and Koch.[2] They found that sulfur in the form of a sulfate is a true nutrient for yeast and is more easily assimilated than is sulfur in an organic form. In view of this the radioactive sulfur was converted into sulfate and added to the medium in that form. The medium had the following composition:

Refined cane sugar	100.00	grams	per	liter
Asparagine	1.5	‘‘	‘‘	‘‘
Mono ammonium phosphate	3.0	‘‘	‘‘	‘‘
Mono potassium phosphate	2.0	‘‘	‘‘	‘‘
Magnesium chloride	0.25	‘‘	‘‘	‘‘
Magnesium sulfate (radioactive)	0.25	‘‘	‘‘	‘‘

It was found necessary to add bios for good growth; beer wort or a yeast extract made by boiling 50 grams of dried yeast in 500 cc of distilled water for 30 minutes proved to be a convenient source. Unfortuately, analysis of these bios preparations showed appreciable amounts of sulfur to be present. When a 1 per cent. concentration of these extracts, which was found to be a favorable concentration for growth, was used, the amount of sulfur added to the medium in the bios-containing extract was approximately the same as the amount of sulfur, in the form of magnesium sulfate, in the medium. This tended to decrease the activity of the final product. Determinations of the variation of glutathione content with the growth period of the yeast were made by the specific glyoxalase method of Woodward.[3] Maximum glutathione yield was reached after three days, which period of time was therefore chosen as the growth period.

The radioactive sulfur used in this work was prepared by bombardment of roll sulfur by 10 Mev deuterons accelerated by the cyclotron of this laboratory. Under this treatment a portion of the S^{34} is converted into S^{35} according to the reaction

$${}_{16}S^{34} + {}_{1}H^{2} \rightarrow {}_{16}S^{35} + {}_{1}H^{1}$$

S^{35} emits beta rays of about 0.107 Mev energy and has a half life of about 88 days.[4] The sulfur was converted into magnesium sulfate by oxidation in a stream of oxygen in the presence of platinum catalysts at 600° C. The SO_3 vapors formed were led into an absorption chamber containing 5 per cent. solution of H_2O_2 and an excess of magnesium oxide, resulting in the formation of magnesium sulfate. The excess of magnesium oxide was filtered out and the solution freed from H_2O_2 by boiling.

Under the bombardment a part of the sulfur was converted into other radioactive elements, principally radioactive phosphorus, which, while not interfering with the growth of the yeast, had to be eliminated when activity measurements were made. When such measurements were to be made, the sulfur was precipitated from the magnesium sulfate solution as barium sulfate, washed thoroughly and dried to constant weight. A portion was weighed in a small nickel boat, a few drops of water added to form a suspension, which was evaporated to dryness to form a thin uniform layer. A drop of egg albumin or gum acacia added to the suspension before evaporation prevented accidental loss of the barium sulfate while measurements were being made.

Since the thin walls of the usual type Geiger counter absorb much of such weak radiation as is emitted by radioactive sulfur, activity measurements were made with a specially designed tube. The nickel boat, containing the sulfur sample, was placed in a side arm which did not permit the rays to reach the counter proper. The tube was evacuated to the desired pressure and the background count taken. The sample was then moved into place with a magnet and the count taken in the usual manner.

After the yeast had grown for three days it was separated from the medium by centrifuging and the glutathione isolated as the highly specific cuprous derivative, by a modification of Pirie's[5] method. Thirty grams of moist yeast containing approximately 30 milligrams of reduced glutathione yielded 20 milligrams of cuprous salt exhibiting the silvery sheen characteristic of this compound in aqueous solution. A portion of the cuprous salt was freed from copper by means of H_2S; the resulting solution was found to be capable of activating the enzyme glyoxalase, thus establishing the presence of free glutathione in the solution. The remainder of the cuprous salt was repeatedly washed by centrifuging until the washings gave no further test for sulfate. A sample of this material, containing 0.3 mg sulfur, gave a count of 150 per minute in the Geiger counter. Another portion, containing 0.25 mg sulfur, was ignited and the sulfate formed precipitated as barium sulfate. This gave a count of 100 per minute. Due to the self-absorption of the beta rays within the different samples, these measurements are only approximately quantitative.

This work would not have been possible without the help and encouragement of Dr. Ellice McDonald, director of the laboratories, and of various members of the staff, and we take pleasure in thanking them. Our thanks are especially due to Drs. A. J. Allen, M. B. Sampson and W. Danforth for the preparation of the radioactive sulfur and to Dr. E. F. Schroeder and Miss G. E. Woodward for the isolation and identification of the glutathione.

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[1] *Saccharomyces cerevisiae,* Frohberg type, was kindly furnished by the Fleischmann laboratories.

[2] H. Sugata and F. Koch, *Plant Physiol.,* 1: 337, 1935.

[3] G. E. Woodward, *Jour. Biol. Chem.,* 109: 1, 1933.

[4] W. F. Libby and D. D. Lee, *Phys. Rev.,* 55: 245, February 1, 1939.

[5] N. W. Pirie, *Biochem. Jour.,* 24: 51, 1930.

RACHEL G. FRANKLIN
BIOCHEMICAL RESEARCH FOUNDATION OF
THE FRANKLIN INSTITUTE, PHILADELPHIA

CRYSTALLINE HORSE LIVER CATALASE

ONE of us (O. D. F.) observed that after dialysis for three weeks near the isoelectric point, a solution of horse liver catalase prepared by the method of Agner[1] deposited a small amount of active crystalline material. Not enough of this precipitate was obtained for accurate analysis.

Later, by modifying the method for preparing crystalline beef liver catalase[2] we obtained crystalline horse liver catalase in good yield. The crystals are in the form of very fine needles. After preliminary purification, including fractional precipitation with dioxane, crystallization was induced by slow addition of ammonium sulfate to the properly buffered catalase in a solution containing 3.0 per cent. of dioxane. Catalase crystals have been obtained also from preparations made by Agner's directions up to the point where the material is adsorbed by passing it through a column of calcium phosphate.

A sample of once-recrystallized horse liver catalase has been found to have a *Kat. f.* of 50 to 55 thousand, which is of the order of magnitude of that of the best preparation of Agner. We do not think that the material is yet entirely purified, since the content of iron is 0.2 per cent. instead of 0.09, which would correspond to the hemin iron. It is possible that our material was contaminated with a small amount of a protein high in iron which was observed during the preparation of the catalase crystals, and which is probably identical with the ferritin of Laufberger.[3]

The percentage of hemin, determined by colorimetry and by analysis for hemin iron, is about 0.9, which agrees with the claim of Stern and Wyckoff[4] that horse liver catalase contains about 0.1 per cent. of hematin.

Treatment of the once-recrystallized horse liver catalase with acetone and HCl split off the hemin which dissolved in the acetone. Evaporation of the acetone caused the hemin to precipitate, leaving a small part of the non-hemin iron in the supernatant liquid. Most of the non-hemin iron was in the protein residue.

Our analysis of the sample of once-recrystallized horse liver catalase showed that the copper content was practically negligible, contrary to the finding of Agner that the copper content of horse liver catalase is high enough to be of possible significance.

ALEXANDER L. DOUNCE
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DEPARTMENT OF PHYSIOLOGY AND
BIOCHEMISTRY, MEDICAL COLLEGE,
CORNELL UNIVERSITY

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[1] K. Agner, *Biochem. Jour.*, 32: 1702, 1938.

[2] J. B. Sumner and A. L. Dounce, *Jour. Biol. Chem.*, 121: 417, 1937.

[3] V. Laufberger, *Bull. Soc. Chim. Biol.*, 19: 1575, 1937.

[4] K. G. Stern and R. W. G. Wyckoff, *Jour. Biol. Chem.*, 124: 573, 1938.

INFECTION OF CHICKS AND CHICK EMBRYOS WITH RABIES[1]

IT is the purpose of this communication to present a preliminary report of observations made on chicks and chick embryos inoculated with rabies virus. These investigations were undertaken in order to study the lesions produced in this species and also to determine the changes which might take place in the virus following its adaptation to this unnatural host.

Rabid dog brain passed once through mice was the source of the virus used in this work. Histologically, this dog brain and the mouse-passage brain showed typical Negri bodies. The inoculum consisted of 0.03 cc of 10 per cent. brain emulsion.

Intracerebral inoculation of day-old chicks was followed by signs of rabies after 19 days on the first passage, and 4 passages did not reduce this period appreciably. There was considerable variation in the incubation period and also in the duration of the disease; some animals died within 2 days after the first signs of the disease, while others showed definite paralysis for 2 weeks before death. All these chicks went through a stage of excitement before the onset of flaccid paralysis.

At autopsy no gross lesions were demonstrable. Microscopic examination of brains and cords revealed many Negri bodies, some quite small, others huge. Non-specific changes in the form of acute necrosis of ganglion cells and massive perivascular accumulations of lymphocytes and large mononuclear phagocytes were present throughout the central nervous system.

Portions of brain from the 4th intracerebral passage in chicks were ground and emulsified and 0.03 cc were inoculated intracerebrally into 13-day-old chick embryos. The eggs were opened and the embryos were inoculated according to the technique which had been developed in this laboratory. After 4 days one embryo was sacrificed and its brain was inoculated into the brains of other embryos; subsequent passages have been made every 6 or 7 days, and the virus is now in its twelfth generation.

We have not allowed any chick embryos inoculated by the intracerebral route to hatch. Several embryos inoculated by this route have died between the sixth and eighth day after inoculation; otherwise there has been no definite clinical evidence of rabies. Most of the embryos appeared vigorous and it is believed that they would have hatched if they had not been sacrificed.

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[1] Aided by grants from the John and Mary R. Markle Foundation.

Microscopic examination of brains and cords of embryos killed on the sixth or seventh day revealed an enormous number of Negri bodies and acute neuronal necrosis. Evidence of inflammation was never very impressive, but there was some phagocytosis of necrotic ganglion cells in the cord.

Sixth passage virus was inoculated in 0.03 cc volume in the brain, in the thigh, on the chorio-allantoic membrane, in the eye and in the amnion of separate embryos. Six days following inoculation two embryos inoculated by each route were killed and fixed for study. Histological examination of embryos inoculated intracerebrally and intra-ocularly showed Negri bodies throughout the central nervous system, in the neurones of the retina and in some peripheral ganglia. Negri bodies were found only in embryos inoculated in the brain or in the eye. Furthermore, two embryos inoculated on the chorio-allantoic membrane were allowed to hatch, and neither one showed any clinical evidence of rabies during a ten-day period of observation.[2]

Experiments are being performed at present to determine the virus content of various organs and tissues of embryos inoculated by various routes, the biological changes which may have taken place in the virus following adaptation to this new host and the histological evidence of change in tropism of the virus.

The work at present indicates that the chick embryo brain is an ideal medium for the propagation of rabies virus. This method of virus culture has the advantage over *in vitro* methods in that one is able to study the pathological changes induced in the embryos by the multiplication of virus. We feel that chick embryo brain provides a richer source of rabies virus than has been obtainable in the past and that for this reason alone it may be of value in the preparation of a vaccine.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

USE OF LUMINOUS PAINT FOR OBSERVATION OF ANIMAL MOVEMENTS IN THE DARK

The behavior of animals in the dark is often a matter of interest, but one which is difficult to study. It might be of value, therefore, to report a technique involving the use of luminous paint. This method was developed as a means for observing the swimming position of the brine shrimp, *Artemia*, when placed in total darkness.

An adult *Artemia* is laid out on a glass slide and carefully dried with filter paper. A drop of "Durofix"[1] is then placed in a watch glass, diluted with acetone, and mixed with luminous paint powder. The mixture is transferred to the surface of the animal on the tip of a suitable needle. After about ten minutes small traces of moisture are applied to those parts of the animal's body which are not too near the paint. Finally more moisture is added and the slide is carefully lowered into a jar of water. Practice is required to determine the best mixture for good adhesion. In successful cases the paint remains attached until the next moult and the animals live for many days.

The blobs of paint affixed to *Artemia* have been usually half a millimeter or less in diameter. Tests have shown that only the non-radio-active paints are satisfactory for such small spots. A paint supplied by Harrington Brothers, of London, gives a glow clearly visible to dark-accustomed eyes for fifteen minutes after daylight activation. Larger spots glow for a longer time.

With animals not so small as *Artemia* radio-active paints would be more useful. The glow which they give is continuous, but unfortunately less bright than can be obtained by daylight activation. The United States Radium Corporation of New York supply a paint which I have tested in dots of various sizes, prepared in the manner outlined above. The smallest spots glowed too faintly to be seen. Larger spots, one millimeter or more in diameter, gave good results.

John H. Lochhead
The Biological Laboratories,
Harvard University

QUANTITATIVE TRANSFER OF AQUEOUS SOLUTIONS

In the study of cell metabolism employing either the Barcroft-Warburg respirometer or the reduction method of Tünberg, it is often essential for the accuracy of the determination that the total volume of "test solution" contained in the side-arm of the vessel be transferred quantitatively to the cell suspension. In order to eliminate the factor of drainage a non-wettable surface is essential. For this purpose a coating of ferric stearate has proven of great utility, far surpassing paraffin, due to its negligible volume, ease of application and absence of contaminated areas on which a portion of the solution may remain. It is applied by filling the vessel with a one-quarter saturated solution of ferric stearate in benzene, draining, and allowing the solvent to evaporate. This leaves a very thin coating of ferric stearate. The hydrophobic surface so formed is not attacked by thirty minutes' exposure to 0.1: N HCl, 0.1 N NaOH, saturated NaCl, petroleum ether, chloroform or ether. Further it does not adsorb methylene blue as does glass, nor interfere either in respiration or dye reduction in any of the systems so far studied. Ferric stearate may also advantageously replace paraffin in coating micro-capillary pipettes, as employed by Wigglesworth[1] in the micro-estimation of chloride. The sample of ferric stearate employed was prepared by mixing ferric chloride with a warm, concentrated aqueous solution of sodium stearate, followed by filtration and washing (*c.f.* Langmuir and Schaefer[2]).

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[1] A waterproof, transparent adhesive, manufactured by the Rawlplug Co., Ltd., London.

[2] I. J. Kligler and H. Bernkopf, *Proceedings of the Soc. for Exper. Biol. and Med.*, Vol. 39, No. 1, p. 212, October, 1938.

ROBERT BALLENTINE

PHYSIOLOGICAL LABORATORY,
PRINCETON UNIVERSITY

AMPHIBIAN GAMETES AS BIOLOGICAL TEST MATERIAL

BIOLOGICAL material suitable for testing physical or chemical variables has not been abundant, dependable nor constantly available. Through the discovery that hibernating frogs can be stimulated by the anterior pituitary hormone to release their gametes, there is now available material which may be the answer to the experimental biologist's needs. Between September and March female frogs can be induced to provide upwards of 2,000 eggs (each) at the identical stage of maturation and 24 hours after pituitary stimulation. The eggs may be stripped from the female as needed, in lots of from 50 to 100, or in case of experiments where quantitative data are desired, entire uteri may be tied off as sacks full of eggs and removed from the body. The eggs from one uterus may be used for control as against the eggs of the other uterus, which are subjected to the experimental variables. The frog testes may either be dissected in Holtfreter's modification of amphibian Ringer's (diluted to 10 per cent.) or the male may be similarly stimulated by hormone treatment to release the spermatozoa into its seminal vesicles. Uniform and concentrated suspensions of spermatozoa may be kept for many hours without loss of inseminating powers. This period is shortened with dilution and high temperatures and may be extended if the suspensions are kept at refrigerator temperatures.

In some recent investigations with both low and high voltage x-radiation, embryos from radiated gametes have shown consistent and quite uniform results. With carefully controlled x-radiation of either sperm or eggs, many of the earlier predictions of Hertwig and of Bardeen have been confirmed. There are, however, many new and biologically significant aspects of this radiation problem, which have been revealed by our modern precision equipment and this newly available biological material. It has been impossible, for instance, to render immotile frog spermatozoa with high voltage radiation even up to 120,000 r., although some abnormal embryos appear when the spermatozoa receive as little as 25 r. Early cleavage of eggs fertilized by radiated sperm is perfectly normal in both rate and pattern. There is, however, some evidence that near 10,000 r. the sperm nucleus is sufficiently damaged as to prevent neurulation, but eggs inseminated with spermatozoa which have been exposed to upwards of 30,000 r. will result in quite normal-appearing tadpoles, which may, however, be haploids. Both frog's sperm and eggs are being used to test, from a biological point of view, the qualitative difference between the soft and the hard x-rays.

The details of these radiation experiments will be reported elsewhere, but it is the purpose of this note to call attention to this extremely abundant and dependable biological test material which can be used along the lines of genetics, cytology, cell physiology and embryology.

ROBERTS RUGH

COLUMBIA UNIVERSITY

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[1] V. B. Wigglesworth, *Biochem. Jour.*, 31: 1719, 1937.

[2] I. Langmuir and V. Schaefer, *Jour. Am. Chem. Soc.*, 59: 2400, 1937.

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THIAMIN AND PLANT GROWTH[1]

By Dr. WILLIAM J. ROBBINS

DIRECTOR OF THE NEW YORK BOTANICAL GARDEN

ALTHOUGH several investigators, including R. J. Williams (1920) and Lepeschkin (1924), had reported a favorable effect of vitamin B_1 or thiamin upon plant growth, their crude preparations contained other substances as well as thiamin, and their results could not be accepted as definitive. Indisputable evidence of the importance of thiamin for plants depended upon the availability of the pure compound. Isolated in crystalline form by Jansen and Donath as early as 1926, thiamin did not become generally available until 1934, largely as the result of the work of R. R. Williams and his associates.

Almost at once Schopfer (1934) demonstrated that *Phycomyces Blakesleeanus* will not grow in a medium of mineral salts, asparagine and sugar unless supplied with thiamin. The demonstration was so striking that further investigations with this organism and with others soon followed until it is now clear as the result of the work of Schopfer, Bonner, Knight and others that thiamin is as necessary in the physiology of plants as it is in the nutrition of animals.

My own interest in thiamin arose from a study of the nutrient requirements of excised roots, initiated in 1917 as the result of a paper by Jacques Loeb in which he suggested that a hormone is concerned in the formation of roots by the leaves of *Bryophyllum calycinum*. It was my opinion that Loeb had not eliminated sugar accumulation in the leaves as the "hormonal" factor, and the experiments on excised roots were initiated to attack that problem directly. In the twenty years since the original experiments a number of people have been associated with me and through their assistance one aspect or another of that problem and related ones have been attacked. W. E. Maneval worked with me in the earlier years; E. E. Naylor undertook a morphological and histological study of the origin of the roots of *Bryophyllum* leaves; Albert Saeger studied the necessity of accessory substances for the *Lemnaceae;* Virginia B. White, J. E. McClary and others have assisted in studies on excised roots of *Zea Mays;* Mary B. Schmidt and F. Kavanagh have cooperated in studies of excised tomato roots and of fungi.

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[1] Presented before the Section on the Botanical Sciences of the American Association for the Advancement of Science, Richmond, Va., December 28, 1938.

Our studies have led us to the conclusion that growth substances are important for plants as well as for animals, that Loeb's original hypothesis is essentially correct, and that one of the important growth substances for plants is thiamin.

Thiamin, also called vitamin B_1 or aneurin, is a definite and specific organic compound of known structure, which is prepared synthetically in commercial quantity. It contains nitrogen and sulfur in addition to carbon, hydrogen and oxygen and is synthesized by combining a pyrimidine, 2-methyl-5-bromomethyl-6-amino-pyrimidine hydrobromide and a thiazole, 4-methyl-5-β-hydroxyethyl-thiazole.

On the basis of our present knowledge it appears that all or almost all plants require thiamin, some of them make it from more elementary materials; others do not and must be supplied with part or all of the thiamin molecule for normal growth. In other words, some plants are autotrophic in their relation to thiamin and others are heterotrophic. In fact, it is possible to divide plants into several groups on the basis of their relation to thiamin. Many kinds require no external supply of thiamin. This group comprises those plants which lack chlorophyll and grow in a medium of mineral salts and dextrose and most, if not all, green plants. It includes, for example, *Aspergillus niger, Agaricus campestris* and *Absidia glauca.* Of 36 saprophytic and parasitic fungi we investigated, the growth of 13 was unaffected by the addition of thiamin to a medium which lacked it. It has been demonstrated that some of these plants which require no external supply of thiamin synthesize it, and it is justifiable to assume that the others in this group also have the same power. It is important to note that the power of synthesis of thiamin is not limited to the green plant but is possessed by yeasts, bacteria and fungi also, because this observation eliminates chlorophyll as a factor essential for the synthesis of thiamin. The green plant is not the sole source of thiamin in nature.

Nearly 100 bacteria, yeasts and fungi are now known to require an external supply of thiamin or its intermediates for normal growth; and further investigation will doubtless materially increase this number. Some of these organisms are saprophytes, but most of them, as might be anticipated, are parasites; the fungi include representatives of the *Phycomycetes, Ascomycetes, Basidiomycetes* and *Fungi Imperfecti.* These plants which require an external supply of thiamin and are unable to make thiamin from the more elementary constituents of the medium differ considerably in their synthetic power. Some are able to construct the pyrimidine portion of the thiamin molecule but not the thiazole part; these must be furnished with the thiamin thiazole for growth. Very few organisms are known in this group. Others can make the thiazole but not the pyrimidine portion of the molecule; these are more common. Some are unable to construct either the pyrimidine or thiazole but can combine the two into the necessary thiamin molecule. *Phycomyces Blakesleeanus* is an example of this group. Finally, there are some plants, for example, most of the *Phytophthoras,* which are so specialized that they are unable to make the thiamin molecule from the thiazole and pyrimidine intermediates. These organisms must be supplied with thiamin as such and resemble in this respect the higher animal. *Rhizopus nigricans* requires no external supply of thiamin, and its growth is inhibited by the addition of thiamin to the medium.

It appears very probable that thiamin is necessary for the growth of all or nearly all organisms. Some of them, however, are capable of making the thiamin they need; some must be supplied with thiamin as such, and between these two extremes there are many gradations in synthetic power. Even closely related organisms may differ in their synthetic power, as has been found for the species of *Ustilago* by Schopfer.

Furthermore, a particular organism under one set of conditions may make sufficient thiamin for normal growth and under another set be unable to do so. We found this to be true for the fungus *Pythium Butleri,* which can not grow in a concentrated salt solution without thiamin but in a more dilute solution constructs sufficient for moderate growth.

The higher plant requires special consideration. Through the technique of cultivation of excised roots of higher plants under sterile conditions it has been possible to demonstrate that although an entire tomato plant synthesizes thiamin, the root does not; it depends upon the shoot for its supply of this essential material. Tomato roots synthesize the pyrimidine portion of thiamin but require an external supply of thiazole. We have maintained excised tomato roots in a solution of mineral salts, pure cane sugar and thiamin for 25 successive passages extending over a period of more than two years and in a solution of mineral salts, pure cane sugar and the thiamin thiazole through 19 passages extending over 20 months. In the same solution without thiamin or thiazole no growth occurs. This extended period of cultivation of excised tomato roots in a synthetic medium is of significance not only from the standpoint of their requirement for growth substances, but also because the nitrogen requirements of the roots during this period were met by nitrates, thus demonstrating that the root of a higher plant can synthesize its proteins from nitrates. Pea roots, as shown by Bonner, resemble *Phycomyces* and require both intermediates. It is clear that the parasitic relation of the root to the shoot involves more than sugar.

This observation raises the question as to how thiamin should be classified so far as plants are concerned. For the tomato plant, thiamin is a hormone, it is formed in the top of the plant and materially affects the development of the root; for *Phytophthora cinnamomi* it is not a hormone, since no part of the plant produces it. We are not justified in calling it a vitamin for the plant, if we hold to the original definition of this term, which limited it to animal nutrition. Depending upon the organism concerned, thiamin may be considered to be a hormone, a vitamin or something which is neither a hormone nor a vitamin. For the time being I have preferred to refer to it and similar substances by the general term "growth substance," meaning a specific organic substance needed in small amounts for the normal development of a living organism.

Thiamin is needed in small amounts. For example, *Phycomyces Blakesleeanus* shows a measurable response to less than three millionths of a milligram and excised tomato roots to one billionth of a milligram.

Functions of Thiamin. Although required in small amounts, thiamin is not to be regarded as merely a stimulant. It plays a definite and significant rôle in the metabolism of carbohydrates and probably in other metabolic processes also. Lohman and Schuster (1937) and others have demonstrated that thiamin combines with phosphoric acid to form thiamin pyrophosphate or cocarboxylase, which in association with a specific protein is concerned in the decarboxylation of pyruvic acid, an important intermediate in the metabolism of dextrose. There is some evidence to show that cocarboxylase is oxidized to thiochrome and that the thiochrome is ineffective or much less effective than thiamin or cocarboxylase, probably because the change of cocarboxylase to thiochrome is not readily reversible. We have found that a substance with the characteristic blue fluorescence of thiochrome appears in mineral-sugar solutions containing thiamin in which tomato roots have been grown and that thiochrome is much less effective with tomato roots than either thiamin or cocarboxylase. It appears, therefore, that one at least of the functions of thiamin is to serve as a precursor of a part of an enzyme system involved in respiration and that it is eventually rendered inactive.

It is probable that this is not the sole function of thiamin. As Williams and Spies point out in their excellent book on Vitamin B_1 it is reasonable to suppose that thiamin has a multiple function as a coenzyme in nature. The best-established ones are the two known reactions of its pyrophosphate, which in association with one protein can bring about a decarboxylation of pyruvic acid to acetaldehyde or in association with another protein can promote a simultaneous dehydrogenation and decarboxylation of pyruvic acid to form acetic acid. It may also have a purely oxidative function and be concerned in the transformation of carbohydrate to fat. At any rate, it seems clear from the work of Peters and others that in a deficiency of thiamin the catabolic metabolism of dextrose beyond the point of pyruvic acid is interfered with.

We have found that *Phycomyces* makes more growth in a medium lacking thiamin if the carbon source is acetaldehyde, ethyl alcohol or acetic acid than it does in a similar medium in which the carbon source is sugar. This might be anticipated if it is remembered that thiamin pyrophosphate is believed to function in the transformation of pyruvic acid to acetaldehyde and to acetic acid. By using carbon compounds simpler than pyruvic acid the need for the changes in dextrose to these simpler compounds is eliminated; in one sense the acetaldehyde, ethyl alcohol and acetate represent predigested food for *Phycomyces.* However, even with these simpler compounds the growth is distinctly limited and is materially improved by the addition of thiamin. In fact, we have been unable to maintain *Phycomyces* in a sodium acetate medium through more than the first transfer, which suggests that the growth made in the sodium acetate solutions is at the expense of thiamin supplied in the spores used as inoculum. If this is correct, the interesting conclusion follows that thiamin is more effective with sodium acetate as a carbon source than with sugar. Our inability to maintain *Phycomyces* in a sodium acetate solution, and the beneficial effects of thiamin on growth in solutions containing alcohol, acetaldehyde or acetate supports the belief mentioned above that thiamin functions also in ways other than the transformation of pyruvic acid.

These observations, though fragmentary and incomplete, suggest that *Phycomyces* may be used with advantage in determining more completely the changes which occur in the intermediary metabolism of carbohydrates. Furthermore, the presence of acetate or similar substances may affect the bio-assay for thiamin by *Phycomyces.*

The Specificity of Thiamin. The discovery of the enormous effect of thiamin on the growth of some plants naturally raised the question as to its specificity. This is particularly pertinent in view of the experience with the auxins. Investigations with *Phycomyces,* tomato roots, pea roots and *Staphylococcus aureus* have shown that thiamin is quite specific. No success has yet attended attempts to replace it with amino acids, various sulfur compounds or by other growth substances, including, among others, indole acetic acid, ascorbic acid, nicotinic acid, lacto-flavine, vitamin B_6, ethylene chlorhydrin, pimelic acid and pantothenic acid. In fact, most changes in its molecular structure render thiamin ineffective; in a few instances they reduce its potency materially. The majority of studies on the relation between structural modifications and effectiveness of thiamin for plants have been carried on by using modifications of the pyrimidine and thiazole intermediates, rather than analogs of the vitamin itself. On the basis of these results it appears, for example, that thiamin is rendered inactive for *Phycomyces* if hydrogen is substituted for the methyl group at position 2 on the pyrimidine ring, all other radicals remaining unchanged. Similar results are secured if oxygen is substituted for the amino group at position 6. Thiamin becomes ineffective for *Phycomyces* if a methyl group is substituted for the hydrogen in position 2 on the thiazole ring, or if acetate, acetamide, ethyl acetate, β-hydroxypropyl, γ-hydroxypropyl, hydrogen or methyl groups are substituted for the β-hydroxyethyl group in position 5; and the activity is reduced to 5 per cent. or 10 per cent. if an ethyoxy radical or chlorine replaces the hydroxyl in the hydroxyethyl group in position 5 on the thiazole ring. It is not possible to discuss here in detail the work which has been done by Knight, Schopfer, Bonner and others on the specificity of thiamin. In our own investigations with *Phycomyces* only one compound of nearly 50 pyrimidines and thiazoles tested was as effective as the vitamin intermediates themselves. This compound has an ethyl group in place of a methyl group at position 2 on the pyrimidine ring. It appears, however, that there is some difference between plants in their responses to different modifications of the thiamin molecule. We are not yet certain whether these modifications function as such or whether the plant is capable of transforming them into thiamin. The specificity of thiamin is doubtless associated in part with its function as a precursor of a part of an enzyme system.

The Biological Assay of Thiamin. Schopfer, Mieklejohn and others have used the growth of *Phycomyces Blakesleeanus* as a means of determining thiamin quantitatively. It is a useful method of considerable accuracy and sensitivity. Since it is being used by various investigators, the following comments based on our experience are pertinent.

Growth of *Phycomyces* in a mineral-glucose medium indicates thiamin or the pyrimidine and thiazole intermediates or both. Growth is not specific for the vitamin as such.

Growth is proportional to the amount of the vitamin and not to the concentration.

Growth is proportional to the amount of the vitamin or to the intermediate present in smaller molecular quantity, provided the mineral salts, sugar or nitrogen supply is not limiting.

The logarithm of the amount of thiamin per flask plotted against the logarithm of the dry weight of the mycelium is a straight line. In a suitable medium this linear relationship extends to 10^{-8} mole of thiamin or a growth of something over 500 mgms of mycelium.

The presence of excess thiazole may influence the results.

The Significance of Thiamin from the Standpoint of Symbiosis and Parasitism. The observations which have been made on the growth in mixed cultures of organisms which lack the ability to synthesize the thiamin molecule or a part of it and those which have the ability is most suggestive from the standpoint of parasitism and symbiosis. We have observed on occasion in our experiments the beneficial effects in a medium deficient in thiamin of a bacterial or pink yeast contaminant on the growth of organisms which require an external supply of thiamin. Our experiments showing that polyneuritis in pigeons may be cured by feeding sufficient amounts of the thiamin intermediates or by injecting them intraperitoneally are probably explained by the synthetic action of microorganisms in the intestinal tract. Schopfer has found that *Rhodotorula rubra,* which synthesizes thiazole but not pyrimidine, and *Mucor Ramannianus,* which synthesizes pyrimidine but not thiazole, grow successfully in mixed cultures in a medium lacking thiamin. In a medium lacking thiamin and biotin Kögl and Fries grew a mixed culture of *Ashbya gossypii* which can not make biotin but makes thiamin and *Polyporus adustus,* which synthesizes biotin but not thiamin.

In spite of the rapid progress which has been made in the last year or two in our knowledge of the relation of thiamin to plants and the light which has been thrown on the general problem of growth substances by this information, there is much more we should like to know about this material and its effect upon plants. What are the conditions influencing its production in the plant? Is the supply of thiamin associated with the shape and extent of the growth curve of a plant? What becomes of thiamin as it is used up by an organism? What functions does it play in the physiology of the organism? Where is it formed in the higher plant and where and how is it translocated? Is its production by microorganisms or its possible accumulation in an adsorbed condition in the soil of any significance in soil fertility, as suggested by Williams and Spies? However, in our enthusiasm, we must not forget that thiamin is not the only growth substance concerned in plant development. For one organism thiamin synthesis may be a limiting factor, while for another biotin, meso-inositol, vitamin B_6, nicotinic amide or some other growth substance may be important and still other plants may require an external supply of more than one. We have found that in a mineral-sugar solution thiamin is the factor limiting the growth of excised tomato roots. In a mineral-sugar-thiamin solution the ability of the tomato roots to synthesize vitamin B_6 becomes the limiting factor. Careful and critical work is necessary, lest we be set adrift in a maze which is none too simple at best.

In any event the investigations on the relation of thiamin to plants promise the possibility of elucidating important questions in general physiology through the study of more easily controlled material than the higher animal. Of all the growth substances probably involved in its development *Phycomyces Blakesleeanus* apparently lacks the ability to synthesize but one, thiamin; the higher animal is unable to make many. It would be difficult to imagine a simpler and more perfect arrangement than *Phycomyces* for studying the function of thiamin. The studies on the relation of thiamin to plants can not help but emphasize that the physiological mechanisms of fundamental processes are much the same in all living organisms, although details differ. It may not be a compliment, but it should be a salutary corrective of undue pride to realize that although *Phytophthora infestans* does not develop beriberi or polyneuritis it requires thiamin in the same form and probably for the same reasons as we do.

OBITUARY

JAMES PLAYFAIR McMURRICH

ON February 9, 1939, at Toronto, Canada, death from coronary thrombosis took suddenly from our midst a famous scientist, Professor James Playfair McMurrich, who was still actively engaged in writing and research, although in his eightieth year. His passing removes a notable and well-known figure from the ranks of biology and anatomy. But many happy memories of his inspiration and leadership remain, while a large number of accomplished researches and outstanding achievements are a lasting memorial of his exceptional ability combined with untiring application.

Professor McMurrich was born at Toronto on October 16, 1859, the youngest of eight children of the Honorable John McMurrich, M.L.C. and Janet Dickson McMurrich. He matriculated from Upper Canada College and early showed his brilliance of mind and interest in science by obtaining the degree of B.A. at the University of Toronto (1879) before he was twenty years old. Two years later (1881) he also obtained the M.A. and was beginning to write articles for scientific journals.

He now began his career as a teacher, and during the first three years he completed his work for the degree of Ph.D., which was awarded him by Johns Hopkins University in 1885. Later, in recognition of his attainments he received the honorary degree of LL.D. from the Universities of Michigan (1912), Cincinnati (1923) and Toronto (1930).

His academic career, while only one phase of his remarkable existence, was in itself a notable one. His fame early went abroad, and changes of position were rapid. The diversity of his earlier teaching posts gives evidence of his versatility and knowledge. He was successively professor of biology, Ontario Agricultural College, 1882–84, instructor in mammalian anatomy, Johns Hopkins University, 1884–86; professor of biology, Haverford College, 1886–89; docent and assistant professor of animal morphology, Clark University, 1889–92, and professor of biology, University of Cincinnati, 1892–94.

During this period an invitation came to him to become professor of anatomy at Yale. This he declined because he felt it outside of his province. When a similar invitation was proffered by the University of Michigan, however, he decided that its significance should not be unheeded, and he accepted, thus making a radical change in his career. This position he retained for thirteen years, 1894–1907, finally returning to his alma mater, the University of Toronto, in 1907, as professor of anatomy, which post he filled brilliantly until his retirement as professor emeritus in 1930 at the age of seventy.

Professor McMurrich made many firm and lasting friends amongst his colleagues, was loved and respected by his students and was stimulating to his staff. He worked consistently for the advancement of the universities to which he was attached, furthered the cause of science and promoted research. As a result of this policy he was instrumental in founding the School of Graduate Studies in the University of Toronto, which grew rapidly under his oversight, for he presided over its council in the honored position of the first dean for eight years, 1922–30, until his retirement.

His scholarship was profound, his memory phenomenal and his mind was forever active, keen and inquiring. His interests covered a great variety of subjects, many of them far beyond his professional field, and his accumulated knowledge was ever a source of wonder and admiration to others. But with all his gifts he was never ostentatious, a becoming modesty gracing all his actions. His mind was so active that he was continually working, studying, investigating. He was an ideal research worker and coupled his genius with such diligence and industry that he carried on and brought to completion much valuable and original research work.

His writings comprise a total of 107 publications on widely divergent subjects. Amongst them are five main groups. The first shows his biological interest, which continued throughout his life, and made him a noted specialist on the morphology, phylogeny and classification of the Actinozoa. Specimens from the deep-sea expeditions of the *Siboga* and the *Albatross* were referred to him for study.

The second group of papers comprises numerous studies on fishes, culminating in a series on the salmon and halibut done while a member of the North American Committee on Fisheries Investigation and also of the Biological Board of Canada. Of this latter body he was chairman for several years during its period of most active development. In this connection he was the honored official representative of Canada at the Pan-Pacific Congress in Sydney, Australia, in 1923.

Embryology, both human and comparative, formed a very keen interest on which much work was done, including the writing of a text-book on the "Development of the Human Body," which ran through seven editions.

A fourth interest of course was anatomy, human and comparative. In this field appeared a text-book of "Invertebrate Morphology," four editions of the Sobotta-McMurrich "Atlas of Human Anatomy," the editing of the fourth edition of Morris' "Human Anatomy" and the writing of the sections on the muscular and vascular systems in Piersol's "Human Anatomy"

The final interest, which became stronger with time and was his main activity after retirement from teaching, was the history of anatomy. Here he produced a notable book, "Leonardo da Vinci—the Anatomist." Well advanced at the time of his death was a large work on the history of anatomy. Professor McMurrich read the classics fluently, as well as modern languages, and even added Arabic to his accomplishments in later years, so that he might read original sources for his history.

He was a great believer in the benefits of organized bodies to further science. He joined many societies in which he took an active part and became a member of their executive boards. He was president of the American Society of Naturalists, 1907, and the American Association of Anatomists, 1908. In the year 1922 he was simultaneously president of the American Association for the Advancement of Science and the Royal Society of Canada.

He was an instructor at the Marine Biological Laboratory, Woods Hole, early in his career, and later became a trustee. For years he served on the advisory board of the Wistar Institute of Anatomy and Biology. Other executive positions were held in the American Society of Zoologists and the Royal Canadian Institute, and he was a member of the Royal Microscopical Society, the American Philosophical Society, London Zoological Society, Academy of Sciences and the Osler Club. In all these he took an active part at times. His strength and physical endurance were truly remarkable and were surprising to those who knew him because he never gave the impression of possessing robust health. He was tall and thin in build, of keenly intellectual appearance, and had a mind always demanding much of his vitality. His interests were always objective, never subjective.

Two fraternities were honored in possessing him as a member, Alpha Omega Alpha Honorary Medical Society and Nu Sigma Nu Medical Fraternity. The latter bestowed on him its rare order of merit and elected him president of its honorary council for two years.

Professor McMurrich had a very human side to his life which made him loved as well as respected. He took great pleasure in meeting people and forming new friendships. He was loyal to all his friends and held their affection. His strict integrity and uprightness commanded the respect of all, while his courtesy and kindliness made him very attractive. He was fond of golf, had a passion for travel, took pleasure in his club memberships and was interested in his church. He showed a completely developed, well-rounded personality that took in every normal phase of life.

In 1882 he married Miss Katie M. Vickers. For fifty loyal, happy years they were constant companions, and the happiness of his home no doubt aided materially in raising Professor McMurrich to his high pinnacle of success. A son and a daughter survive him.

Professor McMurrich's eighty years were filled with the wonderful satisfaction that comes from the fullness of life. He lived fully in every way, he achieved great things, he saw his efforts in many fields come to success, he was honored during his lifetime and appreciated for his accomplishments. And last, though not least, at his passing many mourned, but at the same time carried with them the memory of a great man, whose impressive intellectual ability, honor, integrity, grace and kindliness form a noble inspiration to us all.

J. C. WATT

UNIVERSITY OF TORONTO

CARLOS CLYDE GOFF

1905–1939

In the death of Carlos Clyde Goff, assistant entomologist, on January 13, 1939, the Florida Agricultural Experiment Station lost an unusually fine young man; one whose broad interests and enthusiasm have contributed much to the work of the station and promised more for the future. His quiet friendliness, his kindly wit and his unfailing good humor endeared him to all who knew him.

Mr. Goff's contributions have been in entomology, animal ecology, herpetology and mammalogy. His work for the Experiment Station was the study of the vertebrate pests of Florida crops, and at the time of his death work was under way on the pocket gopher; the land turtle, or Florida gopher; and the Florida field mouse.

Mr. Goff was born on October 2, 1905, at Charleston, Ill. He received his B.S. degree from the University of Illinois in 1928. He continued at the university until 1930, serving between 1927 and 1930 as an assistant entomologist with the State Natural History Survey. He went to Florida in 1930, and his M.S. degree from Illinois was awarded *in absentia* in 1931. In 1934 Mr. Goff took further work at the University of Michigan in mammalogy and herpetology. During his stay at Michigan he completed the course work and preliminary examination for a Ph.D. degree and his research work on field mice was to have been reported as a thesis.

Mr. Goff was a member of the American Society of Mammalogists, the Ecological Society of America, the American Society of Ichthyologists and Herpetologists, the Wild Life Society, the Florida Entomological Society, and the Florida Academy of Sciences.

Mr. Goff's wife died in January, 1937. Besides his daughter, Eva Harriet, Goff is survived by his parents, Mr. and Mrs. J. F. Goff, of Charleston, Ill.; a brother, Joseph, also of Charleston; and a sister, Mrs. Reece Bell, of Oakland, Ill.

Marion N. Walker

Florida Agricultural Experiment
Station, Leesburg

RECENT DEATHS

Dr. Herman Schneider, professor of civil engineering, dean of the College of Engineering and Commerce and director of the School of Applied Arts and of the Institute of Scientific Research of the University of Cincinnati, died on March 28 at the age of sixty-seven years.

Baron Joji Sakurai, president of the Imperial Academy and of the National Research Council of Japan, from 1882 to 1919 professor of chemistry at the University of Tokyo, died on January 28 at the age of eighty years.

Nature announces the death of Dr. H. M. Dawson, professor of physical chemistry in the University of Leeds, on March 11, aged sixty-three years; of Dr. C. M. Jessop, emeritus professor of mathematics in the University of Durham, on March 9, aged seventy-six years; of Dr. Giuseppe Cesàro, formerly professor of mineralogy in the University of Liège, a past-president of the Belgian Academy of Sciences; of Marcel Godechot, professor of chemistry and dean of the faculty of sciences of the University of Montpellier, aged fifty-nine years, and of Dr. A. M. Hocart, professor of social anthropology in the University of Cairo, on March 9, aged fifty-five years.

SCIENTIFIC EVENTS

THE INSTITUTE OF GEOLOGY OF VENEZUELA

The Instituto de Geología in Caracas, Venezuela, was formally opened on September 15, in the presence of President López Contreras, of Venezuela. Classes began that day with a registration of twenty-four selected students.

The institute is fully equipped for the training of students in the fields of general geology, petroleum geology and mining geology. It is housed in its own building, which contains a large lecture hall, several recitation rooms, separate laboratories for chemistry, mineralogy, petrography, paleontology and economic geology, a drafting room, a research laboratory for the staff, a preparation room for the cutting, grinding and polishing of specimens and thin sections and a workshop. Also included in the institute are a paleontologic museum and a large library. All the laboratories are equipped with the latest apparatus for the investigation of geologic problems.

In addition to courses in mineralogy, economic geology, petroleum geology, paleontology, stratigraphy, sedimentation, field geology, etc., basic courses in chemistry, physics, botany and zoology, mathematics, drafting, hygiene, mining and petroleum laws and language are given. The institute also has its own physician, who, in addition to his medical duties, will teach hygiene.

The institute as at present constituted will give a bachelor's degree in geology at the end of four years study, half of the fourth year being spent in the field. It is planned, later on, to extend the scope of the institute so as to be able to grant higher degrees.

While the institute is a part of the Ministry of

National Education, it has been organized by a committee of professional geologists from the Ministry of Industries' Geological and Mining Service. These men, trained in Europe or the United States, now form the board of regents. They are: Drs. V. M. López, *chairman;* M. Tello; P. I. Aguerrevere; Santiago E. Aguerrevere, and G. Zuloaga. The faculty includes: N. B. Knox, technical director and professor of geology; Ely Mencher, professor of paleontology; Bela Murakosy, professor of topography, and Hermann Kaiser, professor of chemistry.

There are no tuition fees for Venezuelans, but candidates must pass examinations in mathematics, chemistry, physics, biology, English and French before being admitted. The course is four years and leads to a degree. Six scholarships have been granted to students from other North and South American countries. Many of the students are on scholarships provided by the oil companies operating in Venezuela, which give the student not only cash to live on but opportunity for field and laboratory work during vacations.

N. B. KNOX,
Director of the Institute

THE TROPICAL STATION OF THE MISSOURI BOTANICAL GARDEN

THE Missouri Botanical Garden, like all similar institutions which are solely dependent for support upon rentals from business property and returns from investments, has suffered a sharp reduction in its income during the past years. Unlike many institutions, the cost of maintaining the estate, city taxes, annual bequests, etc., must all be deducted before money is available for maintaining the numerous activities of the garden. Since the budget must be balanced, the only way to do this is to reduce expenses or increase resources.

An appeal for contributions to a "Friends of the Garden Fund" will shortly be made and it is hoped that this may result in restoring the income to something like it was ten years ago. In the meantime one of the economies which has regretfully been enforced is the abandonment of the Tropical Station on the Canal Zone.

This station was established in 1926, at the time the Powell orchids were acquired, and through the years has been a most helpful adjunct in building up the orchid collection. Recently the station has been the headquarters for expeditions for plants other than orchids, looking towards a more complete study of the flora of Panama.

The Canal Zone Government is taking over the station and will maintain it as a park for the benefit of residents and tourists. Fortunately Paul Allen, formerly manager of the station, will remain in the employ of the Canal Zone, and will be able to act as the tropical representative of the garden. This will make possible the continuation of the work on the flora of Panama, and it is hoped that because of the facilities still available this project will not suffer unduly because of the station ceasing to be an adjunct of the garden.

SCIENCE AT THE NEW YORK WORLD'S FAIR

ACCORDING to an official statement recently issued by authorities of the New York World's Fair, "Science, one of the fundamental principles on which the New York World's Fair has been built, will have a special display of its own, portraying its influence on the individual, the family, education and social life." Dr. Albert Einstein is chairman of the Advisory Committee on Science. He is cooperating with Dr. Gerald Wendt, director of science and education, in endeavoring to present "a dramatically visual program that will be understandable and revealing to the average layman." The exhibit, sponsored jointly by the fair corporation and the American Association for Adult Education, also will include education "as a force in the never-ending search for truth, standing between civilization and disaster." One of the seven exhibits under Science and Education will occupy 10,000 square feet of space in a triangular structure, which will house the "Hall of Man," containing the exhibits on medicine and public health. The official announcement states that "The twin exhibit will deal with ideas, with the true nature of science and education and with their social implications. In the first exhibit the purpose will be to show the 'secret of success' that has brought science to the fore. In the latter exhibit will be featured the responsibility of citizens in a democracy to keep pace with this changing world and the necessity for regarding education as a life-long process. There will be no effort to 'teach' science or to compete with the fascinating commercial exhibits, since science pervades practically every department of the fair. Similarly, in education there will be no exhibit of 'school work,' of school materials or of specific educational institutions."

Museum News describes the building of the New York Zoological Society, which is a one-story structure with a great ball at one corner for showing the "Bathysphere," in which Dr. William Beebe made his deep-sea observations, accompanied by specimens and models of deep-sea fish, and with special bays at another corner for a large habitat group and at one end for the cage of the society's giant panda. At the entrance to the building will be two dioramas showing the effect of time on zoological life, the dioramas representing the New York area a million years ago and to-day. Other exhibits will show brilliantly colored species of living birds and fish contrasted with colorless animals, an electric eel with explanation of how its electricity is generated and used, an insect group and a battery of motion picture projectors showing a series of zoological films. At the exit is a room devoted to information concerning the society, its activities and its objectives. The enterprise is financed by a group of trustees of the society, and is administered by a separate corporation formed for the purpose.

THE AWARD OF GUGGENHEIM FELLOWSHIPS

The John Simon Guggenheim Memorial Foundation has announced the award of sixty-nine fellowships amounting to $150,000. The recipients were chosen from among more than a thousand applicants.

The fellowships are granted to scholars, artists and scientific workers who by their previous work have shown themselves to possess unusual ability. Men and women, married and unmarried, of all races and creeds, who are citizens or permanent residents of the United States, are eligible on equal terms. The fellows are usually of ages between twenty-five and forty years. This year their average age is thirty-six years. They may work anywhere in the world where their work can best be done. Forty-three of the fellows just appointed intend to work abroad in whole or in part. The stipends are usually $2,500 a year.

The fellows chosen are resident in twenty-two states, only five of which are in the East. They were born in twenty-four states and eight foreign countries. Fourteen of the fellows are not college-trained. Forty-seven are members of the faculties of colleges and universities, and twenty-two are free-lance scholars and artists. The University of Wisconsin leads with four members of its faculty. The Johns Hopkins University and the Universities of Missouri and California have three each. Purdue University, Sarah Lawrence College, Cornell University, Columbia University and the University of Chicago have two each.

Fellowships awarded in the sciences are:

Dr. Lawrence R. Blinks, professor of biology, Stanford University, for investigations of the relations of metabolism to the bio-electric properties of large plant cells.

Dr. Maurice Ewing, assistant professor of physics, Lehigh University, his second fellowship, for deep-sea investigations by gravitational and seismic methods.

Dr. Isidore Gersh, instructor in anatomy, the Johns Hopkins Medical School, for studies of the intracellular distribution of certain organic compounds.

Dr. Henry N. Harkins, instructor in surgery, Medical School of the University of Chicago, for research into the nature and causes of surgical shock.

Dr. Louis George Henyey, instructor in astronomy, Yerkes Observatory, University of Chicago, to study the theory of the formation of stellar absorption lines.

Dr. Earl Martin Hildebrand, assistant professor of plant pathology, Cornell University, for research on the *modes of transmission of certain new virus diseases of* fruit plants, with chief emphasis on determining how they are spread by insect carriers.

Dr. Hubert M. James, professor of physics, Purdue University, to make a study of the application of wave mechanics to the computation of intensities in band spectra.

Dr. Charles W. Jones, assistant professor of English, Cornell University, to study European scientific manuscripts of the eighth to twelfth centuries as preparation for the writing of a history of the physical sciences as they were known in the early Middle Ages.

Dr. Leland S. McClung, instructor in research medicine, Hooper Foundation for Medical Research, University of California, for studies of certain disease-producing and food-spoiling bacteria.

Dr. Alfred George Marshak, physiologist, formerly associated with the Deaconess Hospital in Boston, for investigations of the mechanism of chromosome division, especially the nature of the chromosome structure as revealed by response to neutron bombardment in the cyclotron at the University of California.

Dr. Rose C. L. Mooney, associate professor of physics, Newcomb College and Tulane University, for research into the structure of crystals by methods of x-ray analysis.

Dr. Earle Hamlet Myers, instructor in zoology, Compton Junior College, California, to continue his studies of the life cycles of the Foraminifera, with special reference to the role of these organisms in the sea and their significance in geological formations.

Dr. Gregory Pincus, visiting professor of experimental zoology, Clark University, for the continuation of his investigations of the developmental physiology of mammalian eggs and embryos.

Dr. Hilda Florence Rosene, assistant professor of zoology, University of Texas, for investigations of the forces and structures involved in the absorption and transport of water by plants.

Adriaan Joseph van Rossem, curator of the Dicky Collections, to study the ornithological collections of Europe.

Dr. Emil L. Smith, instructor in biophysics, Columbia University, for a study of the kinetics and mechanism of photosynthesis.

Dr. Harold R. Snyder, instructor in organic chemistry, University of Illinois, for a study of the configuration *of nitrogen in organic compounds.*

Dr. Chester Stock, professor of paleontology, California Institute of Technology, for a vertebrate paleontological reconnaissance of Mexico.

Dr. Robert C. Tryon, associate professor of psychology, University of California, to write a book on the inheritance of ability to learn, based upon data derived from a series of experiments on the ability of successive generations of rats to learn their way through complicated mazes.

Dr. Melville L. Wolfrom, associate professor of chemistry, the Ohio State University, for studies of the general methods of investigating the organic structure of natural products as carried on in several European laboratories.

DR. OSCAR ZARISKI, professor of mathematics, the Johns Hopkins University, to conduct researches in the theory of algebraic varieties from the standpoint of modern algebra.

THE ABRAHAM FLEXNER LECTURES AT THE MEDICAL SCHOOL AT VANDERBILT UNIVERSITY

DR. ALBERT SZENT-GYÖRGYI, director of the Institute for Medical Chemistry and professor of medical chemistry at the Royal Hungarian Franz Joseph University at Szeged, Hungary, and winner of the 1937 Nobel prize in physiology and medicine, is the Abraham Flexner Lecturer at the Vanderbilt Medical School this year, having arrived at the school on March 4 for a two-month period.

Dr. Szent-Györgyi has visited the United States twice before, first about 1930 as guest of the Mayo Clinic, and in 1935 he returned as a visiting lecturer at the Harvard Medical School.

He has been an active contributor to scientific literature for about twenty years. In his earlier studies he was interested in physico-chemical problems in biology, such as the phenomena of agglutination, cataphoresis and the effect of electrolytes on albumin, and such biochemical problems as the estimation of free fatty acids in blood.

In 1932 he was able to identify vitamin C, the antiscorbutic acid responsible for the elimination and prevention of the condition known as "scurvy," by the use of hexuronic acid (ascorbic acid) derived from adrenal cortex and from cabbage. In 1933 he prepared large quantities of ascorbic acid from paprika, and obtained a crystalline monoacetone derivative. He has also been interested in the wide-spread subclinical vitamin C deficiency in man.

Dr. Szent-Györgyi delivered the following lectures during March: "General Principles of Biological Oxidation," "Respiration of Muscle," "Fermentation and Some Problems of Intermediary Metabolism," "Vegetable Respiration" and "On Vitamins, Health and Disease." During April he will remain at the Medical School as visiting professor of biochemistry.

The Abraham Flexner lectureship was established in 1927 by the brother of Abraham Flexner, Bernard Flexner, who wrote to the chancellor of Vanderbilt University in establishing the endowment: "It is in my mind to set aside certain securities for the medical department of Vanderbilt University. I would like these securities to be held in trust as the 'Abraham Flexner Lectureship,' the accumulated income to be used at intervals of two years or more as an honorarium to be given to some American or foreigner, highly distinguished in the field of the medical sciences; the lecturer to be in residence for the purpose of contact with faculty and students during a period of approximately two months, and to give a series of lectures, the number and character of which shall be determined by the lecturer himself and the university."

SCIENTIFIC NOTES AND NEWS

THE annual meeting of the National Academy of Sciences will be held in Washington on April 24, 25 and 26. As has already been announced, the first lecture in America under the Pilgrim Trust will be given by Sir William Bragg on the evening of Monday, April 24. The sessions for the reading of scientific papers will be held on Monday morning and afternoon, on Tuesday morning and perhaps on Tuesday afternoon. The annual dinner, at which medals and awards are presented, will be on Tuesday evening. Arrangements have been made to visit the Supreme Court of the United States late on Monday afternoon.

THE American Philosophical Society will hold a general meeting in the hall of the society in Independence Square, Philadelphia, on April 20, 21 and 22. Sessions for the presentation of papers will be held on Thursday, April 20, on Friday afternoon and on Saturday morning. There will be an executive session on Friday morning and an open forum for members only on Saturday afternoon. The R. A. F. Penrose, Jr., memorial lecture will be given on Friday evening by Eduard Benes, formerly president of Czecho-Slovakia. The lecture will be followed by a reception. The annual dinner will be on Saturday evening.

THE honorary degree of doctor of humane letters was conferred by Bridgewater College, his alma mater, upon Dr. William T. Sanger, president of the Medical College of Virginia, Richmond, on April 3 when he made the Founders Day address. The honorary doctorate of laws will be conferred upon him at the commencement exercises of the University of Richmond.

ON the occasion of the retirement of Herbert B. Brooks from the National Bureau of Standards on February 1, his colleagues assembled a collection of his published papers and prepared a biographical note "as a mark of their appreciation of him as a skilful engineer, an inspiring friend, and a wise counselor."

A TESTIMONIAL dinner in honor of Dr. Robert L. Swain, secretary-treasurer of the Maryland Board of Pharmacy, was given on March 29 in Baltimore. Dr. Swain recently resigned the position of deputy food and drug commissioner of the State of Maryland, to accept the editorship of *Drug Topics* and *Drug Trade News,* published in New York.

AT the opening general session of the American Chemical Society, which met at Baltimore from April 3 to 7, presentation of the Borden Award in the Chemistry of Milk was made to Dr. Leroy S. Palmer, professor of agricultural chemistry at the University of Minnesota and dairy chemist at the Experiment Station, and of the Eli Lilly and Company Award in Biological Chemistry to Dr. George Wald, instructor and tutor in biology at Harvard University. Each award is of the value of $1,000.

DR. NORMAN R. F. MAIER, assistant professor of psychology at the University of Michigan, who received the award of $1,000 of the American Association for the Advancement of Science at the Richmond meeting, has received from the university the Henry Russel Award for 1938–39 in recognition of his scientific work. The Russel award and the Henry Russel lectureship were made possible by a bequest of the late Henry Russel, of Detroit, an alumnus of the University of Michigan.

THE Meyer Medal for distinguished services in plant introduction has been awarded by the council of the American Genetic Association to Kate O. Sessions, horticulturist, of San Diego, California. The presentation took place at the Southern California Spring Flower Show, held at Pasadena on April 1, 2 and 3. Miss Sessions, who is now eighty-two years old, has contributed to the horticultural beauty of southern California through fifty years of active work spent there as a landscape gardener and horticulturist. The Meyer Medal had its origin in a bequest by the late Frank N. Meyer, plant explorer of the U. S. Department of Agriculture, who left to his fellow workers in the Office of Foreign Seed and Plant Introduction money for a farewell party in his honor. They elected to use this fund to have a medal struck to commemorate outstanding achievements in plant introduction. The council of the American Genetic Association was appointed the agency to make these awards.

DR. JAMES D. BRUCE, chairman of the division of health sciences of the University of Michigan, was designated president-elect of the American College of Physicians at the recent New Orleans meeting. He will assume office at the next annual convention. Dr. O. H. Perry Pepper, professor of medicine at the University of Pennsylvania, assumed the presidency, succeeding Dr. William J. Kerr, professor of medicine at the University of California. Dr. Allen A. Jones, of Buffalo, was elected first vice-president; Dr. Gerald B. Webb, of Colorado Springs, second vice-president, and Dr. J. Morrison Hutcheson, of Richmond, Va., third vice-president.

ACCORDING to *Nature,* the following have been elected officers of the British Physical Society for the year ending March, 1940: *President,* Professor Allan Ferguson; *Vice-presidents,* Professor G. I. Finch, Dr. Ezer Griffiths, Dr. L. Hartshorn and R. W. Paul; *Honorary Secretaries,* J. H. Awbery and Dr. W. Jevons; *Honorary Foreign Secretary,* Professor O. W. Richardson; *Honorary Treasurer,* Dr. C. C. Paterson; *Honorary Librarian,* Dr. J. H. Brinkworth. The Geological Society of London has elected as *President* Professor H. H. Swinnerton; *Vice-presidents,* Dr. E. B. Bailey, Professor W. G. Fearnsides, Professor O. Jones and Professor C. E. Tilley; *Secretaries,* Dr. Hawkes and Professor W. B. R. King; *Foreign Secretary,* Sir Arthur Smith Woodward; *Treasurer,* F. Ashcroft.

DR. FRANK N. FREEMAN, professor of educational psychology at the University of Chicago, has been appointed chairman of the department of psychology. Concurrently with the appointment, the department has been transferred from the Division of Biological Sciences to the Division of Social Sciences. Professor Freeman succeeds Professor Harvey Carr, who retired last autumn. In the interval, Professor Louis L. Thurstone, Charles F. Grey distinguished service professor of psychology, assumed responsibility for the administrative details of the department pending the appointment of a chairman. The transfer of the department to the Division of Social Sciences for administrative purposes was made because Dr. Freeman is connected with that division. The field of interest of the department will continue to be in both biological sciences and social sciences.

DR. MAURICE N. RICHTER, since 1928 assistant professor of pathology in the College of Physicians and Surgeons of Columbia University, has been promoted to a professorship, and has been appointed executive officer of the department of pathology in the New York Post-Graduate Medical School.

DR. PATRICK H. DREWRY, JR., has been appointed assistant professor of neuropsychiatry at the Medical College of Virginia at Richmond. He is now in London for special study in this field under a fellowship from the Rockefeller Foundation. He expects to begin his work at the college next spring when it is anticipated that the new hospital, which will have an active psychiatric service, will be completed.

DR. J. FISHER STANFIELD, of the department of biology of Knox College, has been appointed assistant professor of botany in the department of science of the Chicago Teachers College. He took up his work there in February.

DR. C. H. O'DONOGHUE, reader in zoology at the University of Edinburgh, has been appointed professor of zoology at the University of Reading, England. He succeeds Professor F. J. Cole.

HAROLD L. MADISON, director of the Cleveland Museum of Natural History, Ohio, retired on April 1.

DR. RICHARD WEISSENBERG, formerly professor extraordinarius of anatomy at the University of Berlin and during 1937 visiting professor of cytology at the School of Medicine, Washington University, St. Louis, has been appointed a member of the Wistar Institute of Anatmoy and Biology, Philadelphia.

DR. HERMAN E. HAYWARD, professor of botany at the University of Chicago, has resigned, effective on March 16, to accept a post with the U. S. Regional Salinity Laboratory at Riverside, Calif.

DR. A. ASHLEY WEECH has been appointed director of the Normal Child Development Study of Columbia University, replacing Dr. Herbert B. Wilcox, who has become director of the New York Academy of Medicine. The appointment took effect on April 1.

M. H. V. VALLOIS, in charge of the anthropological laboratory for practical studies of the Ecole des Hautes Etudes, Paris, since 1937 and professor in the faculty of medicine of the University of Toulouse, has been appointed professor of prehistoric anthropology in the Institut de Paléontologie humaine of the University of Paris. M. Vallois is senior editor of *L'Anthropologie.*

A GRANT of $2,000 from Parke Davis and Company will provide for a year's research at the College of Medicine of Wayne University into the cause and treatment of peptic ulcer. Dr. David Sandweiss and Research Associate M. H. F. Friedman, members of the department of physiology, will be in direct charge of the work. Dr. T. L. Patterson will supervise the research. General investigations of peptic ulcer conducted during the past two years by the department of surgery will be continued in collaboration with the new work.

THE ninth Joseph Henry Lecture of the Philosophical Society of Washington, on "Recent Developments of Cosmic-Ray Investigation," was given by Dr. Thomas H. Johnson, of the Bartol Research Foundation, Swarthmore, Pa.

DR. H. T. DAVIS, professor of mathematics at Northwestern University, will give the academy address at the fifty-third annual meeting of the Iowa Academy of Science at Ames, on April 21. His subject will be "The Philosophy of Science."

PROFESSOR DETLEV W. BRONK, director of the Johnson Research Foundation and of the Institute of Neurology of the University of Pennsylvania, delivered the Louis Clark Vanuxem Lectures at Princeton University from March 20 to 23. The subjects of the several lectures were: "The Social and Biological Significance of the Nervous System," "The Sensory Outposts and Their Messages," "Physical and Chemical Determinants of Behavior Patterns" and "The Cellular Integration of the Organism."

DR. KAZYS PAKŠTAS, professor of geography at the University of Vytautas-the-Great, Kaunas, Lithuania, has been invited to lecture at the summer session of the University of California at Los Angeles from June 26 to August 10 on human and political geography in Central Europe. He plans to spend a year in the United States.

DISCUSSION

A MILITARY CLASSIFICATION FOR FOSSIL FRAGMENTS

PALEONTOLOGISTS have long been forced to use the binominal system in an unorthodox fashion in classifying fossils which are merely parts of an undiscovered, and possibly undiscoverable, organic whole. With increased activity in micropaleontology there come into prominence more and more groups in which zoological relationships may never be determined, so that, if the groups are to be studied at all, strictly artificial classifications *must* be employed.

How important this situation has become may be illustrated by the echinoderms, whose fragments in the form of both holothurian and echinoid spicules, echinoid spines, stelleroid and crinoid ossicles,[1] pedicellariae, fragments of Aristotle's lantern and other isolated plates are being more extensively studied every year. Naturally, if these and other fragments are to have correlative value they must first be classed as so many different bolts, nails or screws regardless of whether or not it can, at the moment, be demonstrated that they were made out of the same metal or in the same factory. But actually most of these groups we now classify as if they were biological units, and give them "generic" and "specific" names.

The infelicities due to the use of these non-biological "genera" also are serious in the more conventional fields of paleontology. Vertebrate paleontologists, for instance, have employed dual classifications long and commonly. Nine "families" and a host of "genera" have been established for fossil vertebrate tracks from the Triassic of the Connecticut River valley alone, and the

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[1] R. C. Moore, *Bull. Geol. Soc. Amer.*, 49: 1918, 1938.

"genus" *Cladodus* includes a type of tooth demonstrated to have occurred in as many as seven families of three distinct orders of sharks. The study of fossil plants is also complicated by nomenclatorial difficulties. For instance, the Pennsylvanian genus *Calamites*, whose living representatives obviously grew as botanical entities, is in fragmentary form, catalogued under no less than a dozen "generic" names! Such a situation, annoying enough to the paleobotanist, is confusion confounded to scientists in related fields.

Thus, all divisions of paleontology have their own specific problems of dual classification. The difficulty, however, is a *general* one, and at least some of the problems might be lessened if merely the incubus of the terms "genus" and "species" could be removed. A satisfactory basis for a utilitarian classification, divorced from these terms, is found in the classical divisions of the Roman Army. The *Ordo militaris*,[2] or "Military Classification," with its approximate classificatory equivalents in the Linnaean, or typical binominal system, follows:

Linnaean	*Ordo militaris*		
Class	Exercitus	—plural	Exercitus
Order	Legio	— "	Legiones
Family	Cohors	— "	Cohortes
Genus	Manipulus	— "	Manipuli
Species	Centuria	— "	Centuriae
Individual	Miles	— "	Milites

Since most attempts to devise, for fossils, designations which are assembled as numbers or as formulae have met with little success, there is retained, for the military classification, a binominal scheme of nomenclature with simple Latin and Greek descriptive terms.

The most important terms of the *Ordo militaris* are the equivalents of the genus and species of the biological classification, *i.e.*, *manipulus* and *centuria*. Their substitution for the old terms may seem a little strange at first, but certainly *manipulus* is easier to use than "artificial" or "form" genus, and it involves no contradiction nor misuse of words. The military system is by no means a panacea to cure all nomenclatorial ills, but its use will at least be unambiguous to the extent that its terms themselves reveal that the writer is dealing with fossils which can be grouped under the same name because of their architectural similarities, and not necessarily because of any real or implied "blood relationships."

Under the "military system" not only the neglected fossil fragments, but also the entities, of which the fragments are only a part, would have a better chance of becoming completely understood. The fact, however, that an entire fossil becomes known and is described under a new name in nowise would throw into synonymy the *Ordo militaris* designations for the possibly many different *manipuli* and *centuriae* fragments which made up the whole. The "military system" terms, if applied in conformity to the ordinary rules of nomenclatorial procedure, would continue to have (special) taxonomic standing, and stratigraphic significance. Furthermore, the fossil fragments themselves, in all cases so much more numerous than complete organic remains, having been christened, would have a far better chance of achieving the paleontological importance which they richly deserve.

Carey Croneis

Walker Museum,
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REVISION OF DENTAL SYMBOLS

The symbols employed by anatomists and vertebrate paleontologists in designating the teeth of mammals is in need of revision. Confusion arises from using the same characters for two different purposes. The same characters are employed in one sense to designate the number of teeth in the dental formula and in another sense to designate the position of teeth in the dental series.

The dental formula is fully established and apparently encounters no objections beyond those of the typist and compositor. When, however, symbols employed in the dental formula to designate the number of teeth in a series are used to designate the position of an individual tooth, confusion arises. For example, a paper recently came to my desk in which a generic description ran thus: "Dentition $I\frac{3}{3}\ C\frac{1}{1}\ P\frac{4}{4}\ M\frac{2}{2}$. $P\underline{4}$ has metacone, etc." In the one instance $P\underline{4}$ indicates that there are four teeth in the premolar series; in the other instance it indicates that the fourth tooth of the premolar series is under discussion. This is common practise, grown up in vertebrate paleontology as a short cut in description.

The form of the symbol used to designate the individual tooth ($P\underline{4}$) is troublesome to the typist and to the compositor. This is true also of the dental formula but that appears as a rule only once in the paper whereas the symbols for individual teeth may run through pages of description and discussion. They will be found at the beginning of sentences and at their end, sometimes at both. This common use renders the symbol a continued source of trouble to the typist because of the need of shifting, and a source of expense to the printer because the symbol can not be set up by machines and must be set up by hand.

Various modifications of the tooth symbol have been suggested. The most satisfactory solution appears to be that of eliminating the dash used as a dividing line in the symbol and bringing the number down on the line of the initial letter, thus: P4. In that way it has the same form and meaning as a date written, Jan. 4. The several members of the premolar series may be designated as P1, P2, P3, P4. The same is true of other teeth in other series.

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[2] *Jour. Geol.*, 46: 7, 975–984, 1938.

Now, having disposed of the dash, it becomes necessary to distinguish between the upper and lower teeth. Let us employ the printer's distinction of upper and lower case. For upper premolars we will use the capital letter as an index to the series, thus: P4, for lower premolars we will use the small letter, thus: p4. This will be found distinctive and the difficulty of typing and type-setting at once disappear. The plan has in its favor the two-fold arguments of distinctness and of economy.

E. S. RIGGS

FIELD MUSEUM, CHICAGO

TERMINAL ZIGZAGS IN SNOWSLIDE STRIATIONS

IN his interesting article on "Snowslide Erosion,"[1] Mr. Dyson invites discussion of the mechanics of the formation of zigzags in the terminal portions of the striae cut by boulders carried in snowslides. It seems probable that this erratic motion of the boulders is brought about by a similar movement of the snow by which they are transported. It has occurred to the writer that the behavior of the snow in this manner may be analogous to that of a viscous liquid upon being poured in a small stream from a moderate height.

As a rather homely example, let us consider the manner in which our breakfast syrup (if we like it thick) behaves when its fall is arrested by the horizontal surface of the pancake. The falling column of syrup does not simply impinge vertically and expand in all directions from the point of contact. Rather, it swings to and fro at the end, laying down an intricate pattern of undulant loops which merge one into another and then spread out over the surface. These loops may sometimes fall with their long axes parallel, but more commonly so that each loop crosses its predecessor at an angle, in which case the end of the falling stream soon assumes a circular motion; seeming to descend in a widening spiral which merges into the surface of the expanding pool of liquid.

The reason for this lateral oscillation in the lower part of a falling stream of thick liquid seems fairly obvious. Briefly, the end of the stream must receive a slight deflection toward one side or another at the moment of contact due to slight irregularities in the surface against which it strikes, so that the stream is bent away from the vertical. If the fluid is sufficiently cohesive internally, this deflection will tend to increase until it reaches a certain amplitude, whereupon it reverses itself. This reversal is due to the fact that the vertically descending portion of the stream surpasses in velocity that which is falling at an angle to the perpendicular and begins to crowd against it so that it is itself deflected from the vertical and in the opposite direction. This new deflection continues to grow until the critical amplitude is again reached, whereupon another reversal occurs. Since the same conditions which give rise to this terminal oscillation also obtain, though to a lessening extent, in the adjacent part of the stream a series of oscillations of diminishing amplitude appears in this region.

Let us imagine this falling stream of syrup confined between two parallel sheets of friction-free glass, sufficiently far apart to permit the stream to fall freely except that its axis must remain oriented in the same plane throughout. Since we are postulating frictionless glass we can probably tip the ensemble to an angle equal to that of the snow slope without upsetting the conditions that cause the oscillatory motion. If the stream were now suddenly to congeal, the figure presented would be not unlike the path of one of the stria-forming boulders. The path of an individual particle in the center of the falling stream of syrup would closely resemble the striae described. Perhaps we may consider the snowslide as a viscous stream confined between the planes imposed upon it by the solid bed and by the gravitational force acting upon it. To the writer it does not seem too fanciful to believe that the moving column of snow may behave in a manner similar to that of the syrup when the forward part of the column is brought to a sudden stop by meeting some obstacle head-on, which obstacle may consist of large rocks, a sharp change in the angle of the slope or simply more snow in a state of rest.

If the analogy here presented be valid, then the zigzags in the snowslide striae should show a greater amplitude near the lower end than at their inception. It should be of interest to inquire of Mr. Dyson whether or not such an increase of amplitude was noted in the final portion of the zigzags at the time of his observations in Glacier Park.

J. ROBERT WELLS

LA OROYA, PERU

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[1] J. L. Dyson, SCIENCE, 87: 365–366, 1938.

A WINTER WHIRLWIND

WHILE driving toward Red Wing, Minn., on the afternoon of November 23, I noticed an old-fashioned whirlwind pass across the road. A slight snow was falling, with the sun visible at some instants. The temperature was 20 degrees above zero and the wind about 8 miles per hour from the northwest. The whirlwind appeared to be the kind I used to see down on the farm in the Ozarks on a warm summer day, except that it was picking up a lot of snow and moving along with the wind. Due to traffic conditions I could not observe any distance up into the air. The whirl was so filled with snow that it was practically impossible to see any objects through it as it passed my path. This may not be of any great interest, but I don't recall reading or hearing about whirlwinds in the winter-time, which accounts for my calling the matter to the attention of the readers of SCIENCE.

H. D. MATTHEWS

MINNEAPOLIS

"TITANS OF THE DEEP"

I WOULD like to correct a rather vital misconception in regard to the film now running in New York City and elsewhere in the country, called "Titans of the Deep." This is being credited to me and my associates, whereas neither I nor any member of my staff of the Department of Tropical Research, nor any one connected with the New York Zoological Society, had anything to do with it.

At the very beginning are shown a few authentic shots of the Bathysphere, but all the rest of the film is the work of Mr. Otis Barton, and was taken in Panama at his own expense and with no relation to the Bathysphere. I never saw any of it until it appeared on a New York screen. Together with my staff, I would like completely to dissociate myself from this motion picture and to have it known altogether as the work of Mr. Barton. In a recent letter he tells me he has been trying to accomplish this correction, but without success.

WILLIAM BEEBE

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SCIENTIFIC BOOKS

STATISTICAL METHODS

Statistical Methods—Applied to Experiments in Agriculture and Biology. By GEORGE W. SNEDECOR. Collegiate Press, Inc., Ames, Iowa, 1938. xiii + 388 pp. Price $3.75.

IN the preface, the author writes: "It is a pleasure to acknowledge the leadership of Professor R. A. Fisher. . . . By his residence as guest professor in mathematics at Iowa State College as well as through his writings he has exercised a profound influence on the experimental and statistical techniques of the institution." It is not surprising, then, that Snedecor's book should resemble R. A. Fisher's "Statistical Methods for Research Workers" more than it resembles the usual text-book on statistics. And the appearance of a sixth edition of the Fisher book (1936) testifies to the assistance that such a book can render to investigators, especially to those working in biological fields. Fisher's book is a reference book, almost devoid of mathematical proof, giving by detailed examination of numerous problems some of the most important principles of statistical research, with special emphasis upon significance tests. Snedecor's book proceeds along the same general lines, but the latter is a little more informal, it devotes a little more space to making plausible what it does not attempt to prove, and it inserts 417 examples, enough to make it a practical text-book as well as a reference book.

The following three problems taken from the first three chapters will illustrate the type of problem in which the author is most interested:

Example 1.10—An entomologist was trying to adjust the concentration of a spray so as to kill 50% of the flies in a container. Having got what seemed to be a satisfactory mixture, he sprayed a batch of 128 flies, killing 55%. Show that this is not a significant deviation from the 50: 50 expectation. 2.30—Assuming that the coefficient of variation of yields in field plot tests with wheat is usually near 5%, would you be surprised if told that in an experiment where the yield was 25 bushels per acre, the standard deviation of plot yield was 0.5 bushel per acre? 3.17—An agronomist interested in the effect of superphosphate on corn yield tried adding the fertilizer to a treatment of manure and lime. Five pairs of plots were tested. The plots with superphosphate yielded 20, 6, 4, 3 and 2 bushels per acre more than their parallels. Was the value of superphosphate demonstrated?

The book contains a number of useful tables for statistical computations. Unfortunately, these are imbedded in the text, instead of being placed in an appendix. Disregarding Table 1.3 as one row of Table 9.1, these tables appear as follows:

Page 58. Values of t at the 50%, 5% and 1% levels. Here t = (Computed average x—Theoretic mean x)/(Computed standard error of the average).

Page 89. Values of the ratio (Range)/(Theoretic standard deviation) for various sample sizes, n.

Page 133. Correlation coefficients at the 5% and 1% levels of significance.

Page 152. Ordinates of the normal curve (4 decimals).

Page 154. Cumulative normal frequency distribution (4 decimals).

Page 163. Chi-square at levels 99%, 95%, 50%, 30%, 20%, 10%, 5%, 1%.

Page 184–187. F = (Larger variance)/(Smaller variance) at 5% and 1%. (Applicable to problems in analysis of variance.)

Page 286. The 5% and 1% points for *r* and *R*. (Simple and multiple coefficients of correlation.)

Page 329. Coefficients and polynomials for terminal values and differences for fitting terms up to the seventh degree.

Page 351. Coefficients for sets of independent comparisons for 2, 3, 4, and 5 groups at equal intervals.

Mention also should be made, in this connection, of the chart on page 70 for estimating the size of sample required for significance in group comparisons.

The foregoing tables indicate that the author's interest centers about significance tests. Such tests appear in a study of means, variances, covariances, regressions and correlations, simple or multiple or partial, linear or curvilinear, interclass or intraclass.

Although the book avoids mathematical proof, there are 175 citations, among which appear the names of Bartlett, Brandt, Davenport, Ezekiel, Fischer, R. A. Fisher, Galton, Gauss, Goulden, Irwin, Lipka, Neyman, Pearl, Karl Pearson, Egon Pearson, H. L. Rietz, Sheppard, Snedecor, "Student," W. R. Thompson, Tippett, Wallace, Wishart, Wilks and Yates. Even those who are interested primarily in theoretic probability and statistics may derive considerable benefit from a perusal of such a book as Snedecor's, where detailed consideration is given to particular problems.

Edward L. Dodd

University of Texas

THE PHYSICAL WORLD

Our Physical World. By Echels, Shaver and Howard. Pp. xi + 801. Benj. H. Sanborn and Company, 1938.

It appears from what we read in the preface of this book that new light came to this dark world in 1929. The depression was an event which transcended in importance the world war. "Since that time the emphasis in curriculum development has been laid upon improving the philosophy of persons connected with education, such as teachers, pupils, administrators, parents and other adults." After some "innovating experiences resulting from the translation into practice of the improved educational vision of the members of the educational staff" of the Pasadena schools this book resulted. "The written statement comes after the innovating, rather than before it." (The preface was not written by the authors.)

To be brief, this book is now to be used as a text in the instruction of pupils of pre-high-school and high-school age in very elementary physics, chemistry, meteorology, geology, biology, engineering and social science, though these terms are not stressed and the material is slightly intermingled. The nature of the contents can be seen from the headings of the divisions or units: Science Changes our Environment; The Structure of Matter; Radiant Energy in Modern Life; Electricity in the Service of Man; The Action of Atoms; Making New Molecules; The Control and Use of Heat Energy; The World of Sound; The Universal Laws of Motion; The Earth, Man's Abode; The Infinite Universe; The Control of Scientific Achievements. As must be perfectly obvious, the treatment of all these topics in a book of even 800 pages is necessarily qualitative and exceedingly elementary.

The authors are not pioneers in this endeavor. Various high schools and colleges have attempted to present courses in general science. In one college with which the reviewer is acquainted this kind of course, though a more exacting one, was required of all freshmen for about ten years but was finally abandoned.

But these teachers are under obligation to teach general science to a large number of very young students. They must make the subject-matter attractive, they must arouse interest. In the text they discuss each unit topic for forty or fifty pages, then there is an "Interpretation and Review," then "Outcomes" under the headings "Understandings and Meanings," "Attitudes and Appreciations," "Techniques and Skills." After this kind of discussion the method changes and we have "Student Activities in the Laboratory." Here a few experiments are described, but they are not written up in the ordinary matter-of-fact manner. Then there are study questions in all manner of forms, historical and qualitative, true or false, choice of words, similarities and contrasts. Finally, at the end of each unit there are suggestions for teachers, including a list of visual aids, films, slides, charts, references, demonstrations and bibliography.

It looks like a full schedule for the teacher. With so many questions of all kinds coming at him has a student a chance to ask a question? Might not some of the extremely light material be omitted? For example, here are a few questions under one general head. "What experiments would you perform to test whether this is true or false?—Knocking on wood will prevent bad luck. A fat person is always good-humored." (The reviewer will try sticking pins into his fat friends).

There are a few scientific errors: "An electron in the outer part of an atom has just as strong an electrical charge as the positive charge in the nucleus" (p. 216). "Hydrogen atomic weight is the unit or standard of comparison for the weights of all other atoms" (p. 294). "All materials expand when heated and contract when cooled" (p 489). At least one in English, "All these particles are too small *to see.*" (If they were large enough they would see something).

But the book is a serious and, the reviewer thinks, a successful attempt to present to young students some of the chief phenomena of the physical world. With competent and enthusiastic teachers a course of study based on this book should assist such students in acquiring a general knowledge of, and, perhaps what is more important, a lively interest in, nature and nature's laws.

Gordon Ferrie Hull

Dartmouth College

REPORTS

THE ROCKEFELLER FOUNDATION[1]

During 1938 The Rockefeller Foundation appropriated a total sum of over $15,000,000. Of this amount, speaking in terms of rough classifications, $3,800,000 was given to the medical sciences, $3,800,000 to the social sciences, $3,000,000 to the natural sciences, $2,500,000 to public health, $1,000,000 to the humanities and $300,000 to rural reconstruction in China.

The foundation's income during 1938 amounted approximately to $7,000,000. In appropriating $15,000,000 it was necessary, therefore, not only to use up the balance carried over from earlier years, but to dip into the principal fund to the extent of $3,755,000.

In carrying out its 1938 program the foundation operated in forty-two countries in all parts of the world. Eighteen of these countries were in Europe, five in Asia, two in Africa, five in South America, ten in North and Central America and the West Indies and two were islands of the Pacific.

Twenty-five per cent. of the money given went to foreign countries, and the remainder, 75 per cent., was for work in the United States.

It was found advisable in 1938 to make large appropriations to four different institutions. Two of these grants were for current support over extended periods, and two were for endowment. These account, in part, for the relatively large total of funds appropriated during the year. To the China Medical Board, the foundation gave $1,580,000, under an earlier authorization, for expenditure over a period of approximately four years. Previously the foundation had made annual appropriations to this board toward the maintenance of the Peiping Union Medical College. Support over a relatively long period has now been given to enable both the board and the college to plan with reasonable assurance for the immediate future.

To the University of Chicago, the foundation appropriated $1,500,000 for the endowment of biological research. The foundation has made grants for the current maintenance of this work for a number of years, and the program has so clearly demonstrated its quality that stabilization of foundation support seemed wise.

To the American University of Beirut, the foundation appropriated $1,000,000 toward the endowment of its medical school, including nursing and premedical subjects. This action has been in contemplation for a number of years, and it is now believed that the university is in a position to raise the supplementary sums required and thus make a substantial addition to its resources.

To the Spelman Fund of New York, the foundation appropriated $2,000,000 for use over a five-year period in support of the fund's program in public administration. Both the foundation and the Spelman Fund are interested in research and training in public administration. The foundation has given assistance to academic institutions; the fund to non-academic institutions. The latter type of program promises significant results and inasmuch as the resources of the Spelman Fund were practically exhausted, the foundation made it possible for this experienced organization to continue its work over the next five years.

Among other large appropriations and pledges made during the year were the following:

Yale University: toward support of the Institute of Human Relations	$700,000
Washington University School of Medicine (St. Louis): for the maintenance of its departments of medicine, surgery, pediatrics and obstetrics	400,000
Graduate Institute of International Studies, Geneva: toward its general expenses	315,000
State Institute of Public Health, Stockholm: half the cost of construction and equipment	270,000
University of Toronto School of Nursing: endowment	255,000
University of North Carolina: for work in drama: endowment ($150,000); current expenses ($33,000)	183,000
Social Science Research Council: for conferences and planning in connection with research in the social sciences	150,000
University of Chicago: for support of psychiatric teaching and research	150,000
The Johns Hopkins University School of Medicine: toward support of the Institute of the History of Medicine	150,000
Washington University School of Medicine: for support of the Department of Neuropsychiatry	150,000

Except in the field of public health, the foundation is not an operating organization. It conducts no researches of its own. Its activities are confined to grants to other agencies—universities, laboratories and research institutes—and to the training, through fellowships, of competent personnel in the various fields of knowledge.

SPECIAL ARTICLES

THE DETERMINATION OF ETHYLENE EVOLVED BY APPLES AND PEARS

The methods described herewith have been developed to fulfil the need for an accurate chemical means for determining the small amounts of ethylene produced by apples and pears. Although several estimations of the amounts of this gas emanating from certain fruits have been made[1, 2] the procedures used are not adapted to small experimental lots of fruit such as are commonly employed in physiological investigations.

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[1] From review of work in 1938 by Raymond B. Fosdick, president.

In preliminary studies undertaken, it was considered desirable to determine whether or not saturated hydrocarbon gases as well as ethylene were present in the vapors emanating from the fruit. For this purpose, a method was used by which the evolved hydrocarbon gases were combusted before and after bromination. The apparatus designed for this experiment is shown in Fig. 1.

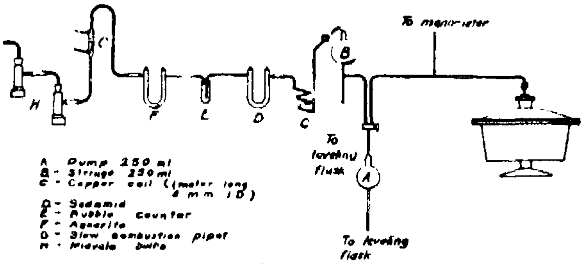

FIG. 1.

The procedure used in making this determination was as follows.

Approximately 1.5–2 kg of fruit, together with 200 ml of 15 per cent. KOH were placed in each of several desiccators, which were then connected to an oxygen supply. After standing for a given period of time at a temperature of 65 degrees F., the KOH was removed and 5 ml of 28 per cent. ammonia solution (to remove acetaldehyde) were introduced into the vessel and allowed to react for one hour. The vapors were then transferred by means of a Topler pump into another container.

The aldehyde-free gas was then equally distributed in two evacuated desiccators. The unsaturated hydrocarbons in one of the vessels were brominated by the addition of 2 ml of liquid bromine. The total hydrocarbons present in the other container were determined by the following procedure.

The gases were extracted from the desiccator by the Topler pump "A" (Fig. 1) and forced into the gas reservoir "B," which was maintained at a slight pressure. By adjusting the stopcock at the top of "B," a constant flow of one liter per hour could be maintained through the analytical train during the entire course of the extraction.

Before the hydrocarbon gases could be oxidized, it was necessary to remove all traces of other organic vapors. This was accomplished by passing the gases through a purification train consisting of a copper coil "C" immersed in a dry ice-ether mixture, a sodamide tube "D," a bubble counter "E," containing phosphoric acid, and an ascarite tube "F." The hydrocarbons, then being the only organic substances left, were oxidized by means of a hot platinum spiral "G,"[3] and the CO_2 resulting was then collected in the Midvale bulb "H" and weighed. This gave the total hydrocarbon content of the vapors. Blank determinations showed that ethyl acetate, ethyl alcohol, ethylene dibromide and acetaldehyde were removed completely by the purification train used, while ethylene passed through and was determined quantitatively.

The vessel containing the brominated vapors was next connected to the analytical train and the gases forced through as described. The excess bromine was removed by a 20 per cent. KOH solution contained in a bubble counter placed between the pump and the desiccator. The data from this experiment gave the saturated hydrocarbon content, the unsaturates being obtained by difference.

Both apples and pears were treated by the above procedure. The results of these determinations before and after bromination show that very little, if any, saturated hydrocarbons occur in the gases evolved by the fruits used. The amounts of unsaturated hydrocarbons (as ethylene) produced by these fruits during ripening are shown in Fig. 2.

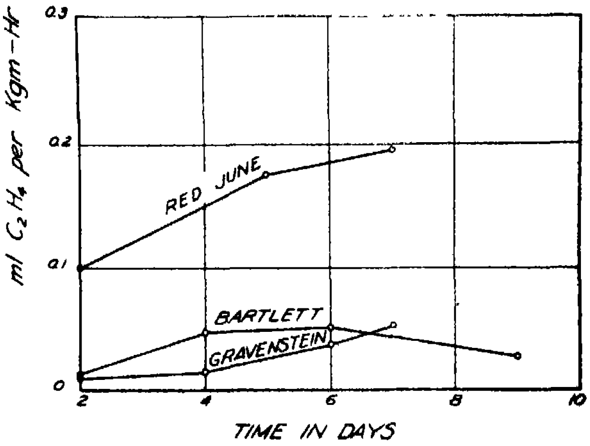

FIG. 2. Ethylene produced by apples and pears at 65° F, determined by slow-combustion method.

Since ethylene or similar olefins appear to be the only hydrocarbon gases present in the fruits used, investigations were undertaken to develop a method by which these could be rapidly and accurately determined. For this purpose, a micro-method was developed by which the ethylene can be determined in a 35 ml gas sample withdrawn from the desiccator at regular intervals during the course of the experiment.

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[1] R. Gane. *Jour. of Pomol. and Hort. Sci.*, 13: 351, 1935.

[2] Joseph B. Niederl and Mortimer E. Brenner, *Mikrochemie*, 24: 134–145, 1938.

[3] Bert E. Christensen and Robert Carleton. *Ind. and Eng. Chem.* (*Anal Ed.*), 9: 400, 1937.

Using this procedure, the amounts of ethylene produced by several varieties of apples have been determined and are shown graphically in Fig. 3. This

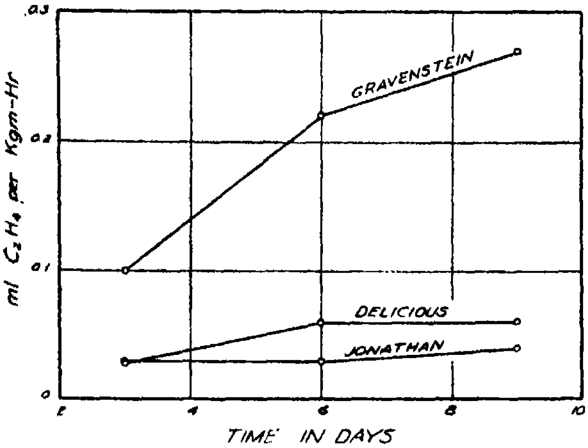

FIG. 3. Ethylene produced by 3 varieties of apples at 65° F, determined by micro-bromination method.

method has the distinct advantage in that a small amount of fruit can be enclosed in a vessel and the ethylene evolved accurately and rapidly determined at regular intervals during the course of any experimental treatment to which the fruit may be subjected. A detailed description will be presented in a forthcoming publication.[1]

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ROLE OF HORMONES IN THE SEXUAL REACTION OF HETEROTHALLIC ACHLYAS

THIS communication, a preliminary report of experimental work on an undetermined species of *Achlya*, a genus of the Saprolegniales, more clearly establishes the role of hormones as activators and coordinators in the sexual reaction in the phycomycetous fungi. These hormones, or specific sexual substances, would fall into the group of diffusion hormones or diffusion activators according to the classification of Huxley.[1]

The sexual reaction in this heterothallic species is under hormonal control at least until the time of the formation of the basal wall of the oogonium. In the time which elapses between the approximation of the ♂ and ♀ mycelia and the formation of the basal wall of the oogonium, four specific substances are involved: two produced by the ♀ initiating specific responses in the ♂, and two produced by the ♂ bringing about specific reactions in the ♀. These hormones and their specific actions are summarized in Table 1:

TABLE 1*

Hormone	Produced by	Affecting	Specific action(s)
A	♀-vegetative hyphae	♂-vegetative hyphae	Induces formation of antheridial branches
B	♂-Antheridial branches	♀-Vegetative hyphae	Initiates the formation of oogonial initials
C	♀-Oogonial initials	♂-Antheridial branches	(1) Attracts antheridial branches (2) Induces, in connection with a thigmotropic response, the delimitation of antheridia
D	♂-Antheridia	♀-Oogonial initials	Brings about the delimitation of the oogonium by the formation of a basal wall

* See Fig 1.

The evidence for these specific substances may be considered under a number of headings as follows:

(1) The sequence of events and the time intervals involved indicate a hormonal coordinating mechanism (see diagram). The time intervals may be varied by changing environmental conditions, but they always remain proportionately the same and no change in the sequence has ever been observed.

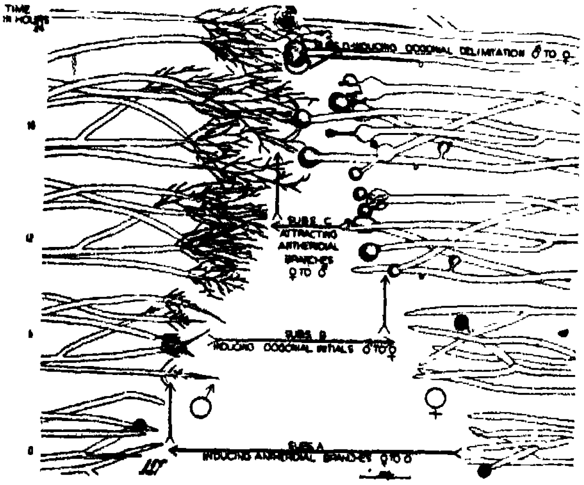
TIME IN HOURS
24
18
12
6
0
SUBS D INDUCING OOGONIAL DELIMITATION ♂ TO ♀
SUBS C ATTRACTING ANTHERIDIAL BRANCHES ♀ TO ♂
SUBS B INDUCING OOGONIAL INITIALS ♂ TO ♀
♂
♀
SUBS A INDUCING ANTHERIDIAL BRANCHES ♀ TO ♂
100

FIG. 1

(2) Telomorphotic (distance) responses regularly occur in both ♂ and ♀. (The formation of antheridial hyphae, the first step in sexual reaction, often occurs in a mating on a nutrient agar media when the ♂ and ♀ mycelia are as much as 6 mm apart, a distance 7.5 times greater than that shown in the accompanying diagram). These distance reactions, all essentially similar, have been observed in the following experi-

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[1] Published with the approval of the Monograph Publication Committee, Oregon State College Research Paper No. 14.

[1] J. S. Huxley, *Biol. Rev.*, 10: 1935.

mental conditions: (*a*) In matings of ♂ and ♀ on various nutrient media; (*b*) in water culture matings; (*c*) in matings on agar in which the two sexually opposed strains were separated by a dialyzing Cellophane membrane; and finally (*d*) in single water cultures in water in which the opposite strain had previously grown, the water having been passed through a Seitz bacteriological filter. In this particular case a ♀ will only react when placed in water in which a ♂ has previously given the initial sexual reaction.

(3) The effects of variations in the composition of the medium offers a third body of evidence. By changing the composition of the medium the reaction can be stopped at times coinciding with the specific actions of the several hormones. These effects may depend either on the production of the substances involved or the ability of the opposed strains to react to them.

(4) Further evidence is furnished by interspecific matings between this species and *Achlya bisexualis* Coker. In each of the two reciprocal matings, *A. bisexualis* ♂ × *A. Sp.* ♀ and *A. bisexualis* ♀ × *A. Sp.* ♂, partial incompatibility is encountered. In the former the reaction stops at the time of differentiation of antheridia, while in the latter the female fails to produce oogonial initials in response to the substance produced by the exceedingly plentiful antheridial branches. These differences indicate a rather high degree of specificity of the hormones. Complete incompatibility would result if the ♂ were unable to react to hormone A of the ♀.

All the plants used in this work remain perfectly sterile in single culture, oogonia and antheridial branches forming only when ♀ and ♂ mycelia are brought together. Adequate controls have been employed throughout. A full account of the work which is summarized here will be published in the near future with complete data and methods.

The role of hormones as activators and coordinators in the sexual reaction is outlined in the accompanying diagram. On different media and under different experimental conditions the time and space intervals involved are considerably varied.

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VITAMIN C TREATMENT IN LEAD POISONING

IN a certain industrial plant where the lead hazard was exceptionally great, due largely to dust and spray, 400 workmen were examined clinically and with a differential blood count. About 40 per cent. showed distinct lead absorption or poisoning.

Of these 160, a group of 34 was selected for treatment with vitamin C (ascorbic or cevitamic acid), a treatment suggested by the bad condition of gums common to scurvy and severe lead poisoning. Half of this group was given 100 mg of vitamin C daily (but no extra calcium) for several weeks. With practically all of them there was a marked gain in vigor, color of skin, cheerfulness, blood picture, appetite and ability to sleep well. The basophilic aggregation test of Dr. C. P. McCord also indicated improvement. A typical case is reported below.

Workman Number One: Clinically diagnosed by one of us (E. J. A., a physician) as chronic lead poisoning. The man showed marked tremors, sleeplessness, a bad blood picture (differential count of white cells), nervousness. He was underweight and easily fatigued and had a sallow complexion. After five weeks of vitamin C treatment the tremors had disappeared, his complexion had greatly improved, his blood picture was encouraging, he enjoyed normal sleep, was cheerful and not easily tired.

The other half of the group of 34 continued their previous calcium gluconate treatment to drive toxic lead into the bones and supplemented this treatment with 100 mg vitamin C daily. They gained in health but not so well as the 17 men given vitamin C alone.

At this stage the research was transferred to Oberlin College, where 14 local house painters were examined. Judged by the combined evidence of a clinical examination and a differential blood count, half of these men showed enough lead absorption to call for treatment or greater precautions. Three of them were studied intensively for several weeks with careful analysis of urine for lead and vitamin C. Each was given 200 mg of vitamin C daily, in one case totaling 6,800 mg.

The chart for Painter Number One, as rather typical of all three, is reproduced here. This man, a painter and sprayer, was diagnosed by a physician experienced in observation of lead poisoning as a chronic case. After only four days of vitamin C treatment he felt pleasantly lazy and sleepy but not

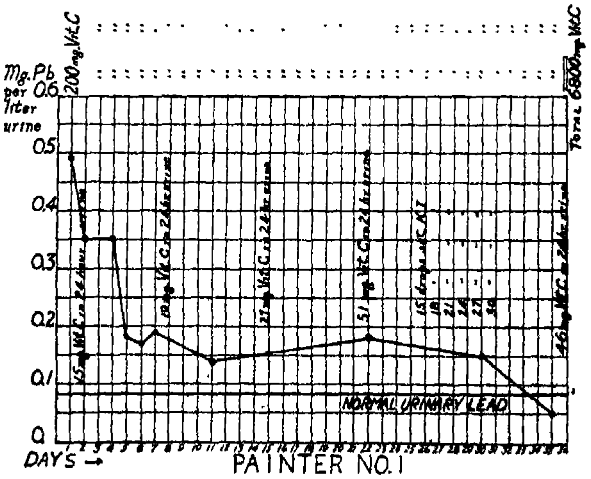

FIG. 1

tired. In a few days more he "felt fine," ready for work and fresh at the end of a hard day. The differential white cell count showed decided improvement, and lead excretion fell from nearly 0.5 mg per liter of urine to normal.

Four other painters, positively known to have selected for many years a diet unusually rich in vitamin C, were examined for lead and vitamin excretion in urine. Urinary lead was near that of the average man and vitamin C excretion high.

The conclusion, supported by test-tube experiment, is that vitamin C reacts with toxic lead ions to form a poorly ionized and much less toxic compound. Therefore lead destroys this vitamin, so necessary to buoyant health, while generous vitamin C supplements to the diet remove the lead from the field of action.

Any fear that the lead is stored dangerously by this reaction is met by Sollman's parallel observation that during deleading with potassium iodide, urinary lead generally decreases because the lead potassium iodide compound is absorbed by the liver and excreted in the feces with the aid of the bile. Analysis can justify a similar explanation for final disposal of the lead-vitamin C compound.

The obvious conclusion is that men exposed to lead hazard should be advised to include in their diet plenty of such rich sources of vitamin C as tomatoes (fresh or canned), raw cabbage, oranges or grapefruit, raw spinach (or even cooked, in very little water), raw turnips, green peppers, cantaloupe, etc. Or they may take 50 mg in a vitamin C tablet as an addition to the diet. The average healthy man excretes 25 to 35 mg vitamin C daily. Any excess intake is used to restore depleted reserves or is excreted.

A full report on this work is to be published in a medical journal later.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

IRON HEMATOXYLIN STAIN CONTAINING HIGH CONCENTRATION OF FERROUS IRON

In the study of some recently prepared permanent mounts of tissue cultures, a slightly modified Janssens' iron hematoxylin was used as a stain. This stain was made up as follows: Water 100 cc, ferric ammonium sulfate, violet crystals, 40 g, hematoxylin (pinkish brown powder when finely ground) 1 gram dissolved in 25 cc absolute methyl alcohol, glycerin 25 cc.

In one of these mounts it was noted that the cell nuclei were beautifully stained a clear, deep blue, absolutely free from the opacity sometimes met with in some poor iron hematoxylin stains. The cytoplasm, however, was stained a distinct brown color.

From the appearance of this preparation it seemed obvious that in the Janssens' stain there were two quite distinct staining agents. This was also strongly suggested by the color changes in the staining solution itself. This freshly prepared staining solution was always a clear, deep violet blue and was most vigorous in its action. After 24 hours, however, this color changed to a more and more marked yellow shade of brown and the solution lost some of its staining vigor. From these observations it seemed that the two staining agents were probably iron salts of hematoxylin in different stages of oxidation. The deep and unusually translucent blue of the nuclear stain was so selective and so sharp that it seemed highly desirable to obtain this stain in a more reliable form and without the complicating and relatively opaque brownish stain.

It seemed likely that the blue stain was from a relatively reduced form of the iron hematoxylin salt, while the brown was from a relatively oxidized form. On trial it was found that the fresh blue Janssens' hematoxylin could be changed to a brown solution by addition of hydrogen peroxide, while addition of a reducing agent, sodium sulfite, resulted in some resumption of the blue color in a solution of Janssens' hematoxylin, which had aged to a brown color.

With this confirmation two lots of hematoxylin were made up according to the above formula except that while the first used 40 grams of *ferric* ammonium sulfate crystals, the second used 40 grams of *ferrous* ammonium sulfate crystals. Of these the ferric ammonium sulfate solution showed the usual deep violet blue which in 24 hours changed to brown. The ferrous ammonium sulfate solution showed an extremely pale washed-out blue, which, however, did not change to the brown color at the end of several days. A third lot was then made up in which half of the iron salts was in the ferrous and half in the ferric form. In this solution 20 grams each of ferric and ferrous ammonium sulfate were used. The resultant solution at once assumed a deep-rich blue, even deeper in color than the freshly prepared Janssens' hematoxylin. This solution was still a deep violet blue with only a trace of brown color at the end of a number of weeks.

Staining tests with this solution, which we are now using routinely for sections and for whole mounts of tissue cultures, have shown it to be a highly selective, clear, transparent blue nuclear stain which requires little or no differentiation other than soaking for a few minutes in a number of changes of distilled water or in Van Giesen picrofuchsin. As an instance typical of the ease of use and reliability of the stain, a series of slides was stained for different lengths of time in a trial lot of this solution which contained only 10 grams each of ferrous and ferric alum, instead of the 20 as above described. The slides were then counterstained with Van Giesen picrofuchsin (5 minutes) in the usual manner. The slides stained 2 minutes were fairly satisfactory; those stained 4 minutes were nearly ideal; those stained 15 minutes could hardly be distinguished from those stained 4 minutes, and it was only when the staining was carried up to about an hour that the image showed signs of loss of detail from overstaining.

From these preliminary studies it is suggested that the combination of a high concentration of ferrous and ferric salts serves to maintain an oxidation reduction equilibrium in the solution which is far more suitable for the formation and preservation of the selective blue hematoxylin-iron salt than is either the ferrous or the ferric salt alone. It appears that the stain, above described, is highly selective. It is relatively insensitive to variation in staining time and may be used as practically a progressive stain with little or no differentiation. This differentiation, when required, may be done by time rather than by inspection. The solution is far more stable than either Weigert's or Janssens' hematoxylin, is easily prepared and does not require any aging. This stain has not given satisfactory results when used in contact with at least some metals, as, for instance, monel.

In conjunction with Dr. Ralph Lillie, of the division of pathology, a more detailed study of this stain is being carried on at this institute in order to more accurately define its properties. Even with the data above presented, however, the question is raised as to whether or not many, or possibly even all, of our current iron hematoxylin stains would not be substantially improved by substitution of a mixture of ferrous and ferric salts or some equivalent oxidation-reduction mixture for the ferric salts now in current use.

No studies have as yet been made on the action of this stain on such cell organs as mitochondria. These considerations will be left to a later date.

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"SPOTTING" SPECIMENS FOR CATALOGUE NUMBERS

ENAMEL spots for catalogue numbers on minerals and fossils have been superseded in this department for some years by spots of clear Duco cement. Applied direct from the tube, the cement is more convenient to handle than paint, and it hardens more rapidly. Its surface takes india ink well from a pen, and the inconspicuous character of the cement will be especially appreciated when numbers must be applied to transparent crystals.

A. S. WARTHIN, JR.

VASSAR COLLEGE

THE CARE OF SKULLS AND SKELETONS OF SMALL ANIMALS

BEFORE shipping small skulls and skeletons, or before allowing them to be cleaned by dermestid beetles, it is usually desirable to dry them as completely as possible.

The automobile, probably now used by the majority of collectors, makes an ideal desiccating machine. Small osteological specimens fastened under the hood by wire, in the hot air stream from the fan, become perfectly dry in a day or two, even in damp weather, if the automobile receives ordinary use. A minimum of preliminary cleaning is necessary, and brains need not be removed from skulls up to the size of a rat's. Enough muscle and tendon may be left on small skeletons to hold the bones firmly together. Fly eggs fail to hatch, and maggots quickly die under this treatment.

No claim to originality is made for this method, but it has proved so useful that it seems worthy of dissemination.

RICHARD M. BOND

NATIONAL PARK SERVICE
PORTLAND, OREGON

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EXPANDING CONSCIOUSNESS AND DEMOCRACY[1]

By Professor H. W. SHIMER
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From the point of view of a student of evolution it would seem that much of the trouble in the world to-day results from the age-old conflict between two major impulses of life. These are the impulses of each individual organism to live its own life in unhampered freedom, and the impulse of each individual to seek association with its own group. Life tends to vary, to differentiate, to individualize, a tendency which is in continued conflict with the "herd instinct," the impulse of individual organisms to come together for protection and aggression.

Evolution implies that through the long history of life new types have come into existence through descent, with slight modifications, of new individuals from pre-existing individuals. Life would long ago have vanished from the earth in the face of the difficulties and dangers in its environment, had it not been for this overwhelming urge of each individual organism to live and to reproduce.

While, however, life was limited to one-celled and self-sufficient organisms, there could be little advance in evolution. Later single cells came together to form many-celled larger units, with their enlarged possibilities. In each of these the component cells divided the labor of preserving the larger organism, and hence the existence of each individual cell came to depend on the existence of the other cells. And it is possible that in these larger many-celled organisms may have arisen the first diffused beginnings of the impulses which are sometimes classified together as the herd instinct.

From such cooperative beginnings the evolutionist traces the long succession of increasingly compact groups up to their culmination in the swarm, the herd, the pack and, in man, the tribe and nation. An underlying principle in this evolution is that "in union there is strength," a greater probability of survival of the larger unit, whether the union be physical, instinctive or consciously social.

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[1] Address of the retiring president of the Boston Geological Society.

All such growth, however, of the "coming together" impulse brings about as a necessary corollary a *subordination* of the more personal interest of the individual. The later developed unity frequently asserts its interest at the expense of the interest of its components. An animal in a trap may gnaw off its leg, itself composed of myriads of cells, in order to save the larger unit. The non-working drones are killed by the workers in a hive. Offending individual man is put in prison. In such cases the individual self-preservation instinct must subordinate itself to the impulse to preserve the herd, the larger unit.

Thus, throughout this long course of evolution, may be seen the expansion of organic life, with its attendant first beginnings of consciousness, from the first single cells, with their ruling impulse to live as individuals, through the many-celled organisms, and on to the larger groups where the interest of the larger cells is at times completely dominant over that of the individuals.

In conjunction with the evolution of the instinct for self-preservation, there has taken place a progressive expansion of the reproductive impulse, especially into the parental instinct. The more lowly animals of the Paleozoic gave no care to their offspring after the eggs were laid. Such increased care for the next generation appeared with the advent of certain fish, insects and birds and the mammals of the Mesozoic, if we may judge from the behavior of the closest modern descendants of these groups. The parental instinct then enlarged its range of expression from the immediate offspring to other members of the herd. In more advanced man the love of children and neighbors begins to enter the more *outlying* fields of the weaker members of his species, the under-privileged and the less normal.

Thus as the student of evolution looks back over the series of living forms that have populated the earth for a billion years, he sees them controlled by impulses that foster both variation and protection, radicalism and conservatism. He may consider these instincts as expressing a gradual expansion of consciousness. During this evolution, consciousness, at first expressed simply as awareness, has expanded from the individuality of the single cell, through that of the many-celled individual, to the enlarged sense of the unity of the group composed of many multicellular organisms. The behavior of the higher organism depends on a series of impulses that becomes more and more complicated—the impulse to preserve its own life at all costs coming into conflict with its impulse to preserve and care for its young and with its impulse to enter into large groups for the aggressive and defensive benefits it receives from such association in the group. In the lower animals, as, for example, in insects, there is little conflict in the group because there is little individuality. But, in mammals, an increasingly sensitive nervous organization and progressively larger brains introduce the capability for more varying individual action.

Insects are encased in a completely enveloping external skeleton of chitin. This necessitates molting for growth and restricts the possible size of the organism. Moreover, chitin is easily modified into organs specialized to the needs of each species; only a small amount of intelligence is required to use these implements evolved for each particular use. Hence the reaction of each insect to any particular environment differs little from that of any other insect; it has specialized tools all ready to meet it.

In contradistinction to the insects, the vertebrates possess an internal skeleton, to the outside of which the muscles are attached. Vertebrates can thus grow without molting and can reach a much greater size and develop a much more complex nervous system. The internal skeleton is not in direct contact with the environment, nor is bone so easily modified or so capable of being fitted to such a variety of uses as is chitin. Not having been able, accordingly, to evolve a special instrument for each particular environment, vertebrates must modify the *use* of what they have; in other words, they must use their brains to solve each problem. They have thus developed intellect to supplement instinct, which is the sole resource of insects.

As has been seen, increased use of the brain results in a greater variation of action, in increased development of individuality. But when vertebrates began to band together for getting a better food supply and better protection of the young, they had to give up a certain amount of this individuality of action. The strong herd of herbivores may eat almost where and when it will, but the individual must secure its food in close competition with the other members of the herd. The carnivore pack can capture larger and fleeter animals than can each member of the pack alone, but they must compete with one another over the captured prey. Such aggregation of individuals into herds or packs is characteristic of the higher mammals, including the higher Primates, to which man belongs. A tribe can survive where a single family can not. An aggregate of tribes, or nations, has greater survival value than a single tribe; it tends to subordinate intertribal warfare to the competition with other nations. The next logical step would be the international Earth Nation which should tend toward subordination of warfare between nations to the problems of cultural survival and improvement of all the peoples of the earth.

Consciousness, starting thus as the awareness of an organism to the individual problems of food supply and self-preservation, expands to the increased instinctive care of the young. Because of their internal skeleton, the vertebrates have found the need of increased use of the brain to solve their increasingly complex problems of survival. This increasingly larger brain in the higher mammals and the necessity for individual decision at frequent intervals result in the increasing emergence of a certain faculty of curiosity in the higher mammals. When the individual is somewhat released from its necessary concern with the getting of food and the avoidance of enemies, curiosity about the environment grows. This is well seen in cattle, horses and the mischievous monkeys. And, finally, the philosophic and scientific curiosity of man results in further accentuating the variations among individuals. Such variations are still in conflict with the ancient and powerful instincts for food, safety and family. Fears and hopes connected with these self-preservative instincts may be so increased by education or propaganda that for a time individual man may be willing to permit his thoughts and actions to move in only directed grooves. Yet even in such times of public fears and stresses and emotional urge, there always remain some individuals whose minds can not be kept along ordered grooves; they persist in seeing avenues to be explored along forbidden lines. Such men formed the majority of immigrants into new territory. They were the pioneer philosophers and scientists at times when it was dangerous to think along new lines. A nation may be kept in an unchanged condition only by banishing or killing these mentally restless individuals.

To recapitulate, when man comes to look back upon the way his animal ancestors have traveled, he finds in himself the field of conflict between ancient instincts. He must obey the impulse of self-preservation. He feels the urge to protect his young. He is impelled to join with others of his species for protective and offensive advantages. His tendency to variation as an individual must thus be at times subordinated to the interest of the group. In human affairs, as in geologic processes, centrifugal and centripetal tendencies must be in a state of constant readjustment.

Heraclitus of Ephesus, some twenty-five centuries ago, in his statement, "Panta rei," expressed the universal law of movement, that all things are being perpetually transformed into new shapes. The geologist sees the wearing away of solid rocks, the removal of the dissociated matter to lower levels, with the consequent lowering of mountains and filling in of basins. The final goal of such processes would be a featureless landscape. Such a final state of quiescence, such cessation of the labor of running water, has never been attained, for new lands are being raised and new mountains are formed. Our backward glance over many millions of years of earth history shows these opposing forces of change to have been constantly operative.

The biologist sees the gradual dissolution of the physical forms of organisms into the featureless goal of the physical elements, but throughout earth history this goal has never been attained for all animals at any one time. For death and dissolution of the old forms are always accompanied by the birth of new organisms and their struggle to maturity and old age.

Thus neither life nor the earth upon which it exists is static. There are always two opposing forces at work—one tending toward a featureless order or death, the other towards diversity, disorder.

This universal law of movement is operative in man's social organization in all its forms from the home to the nation. We see here, too, a constant struggle between diversity and featureless order. Man's large and active brain produced the printing press, which enabled man to make and preserve records of what his immediate forerunners have done, thus giving to each succeeding generation a fuller social inheritance and a closer contact with the present world. Such resulting reaction of mind on mind has brought about the extraordinary increase in diversity of modern life and its accompanying subdivision of labor, a diversity that inevitably produces inequalities in the social structure. This has naturally called forth a demand for a greater measure of order among many of these conflicting diversities. In the attempt to meet this demand we witness to-day experiments in various forms of autocracy and regimentation. In any such panacea, whatever tends to reduce diversity of thought weakens the long-time vitality of the group or nation that tries it; it is, by analogy with geological and biological processes, a step towards its final dissolution. In the words of A. G. Huntsman, the perfect goal in a social structure would seem to an evolutionist to be the welding of the fullest possible diversity into an orderly, harmonious whole. In the extent to which this problem is solved is shown the mental caliber of the social group.

The many forms of government in the modern nations may be classified according as they emphasize the dignity of the individual, that is, the contribution that varying thinking may give, with the resulting tendency toward diversity; or, on the other hand, as they emphasize the enhancement of the state or nation, with the consequent tendency toward stagnation and the ruthless subordination of the individual toward conformity with one fixed ideal.

To the student of evolution who looks back over the history of the earth and its burden of living forms, who sees in both geologic and organic evolution the never-ending conflict between forces making toward diversity and forces making toward order and conformity, the ideal government would seem to be democracy. Life would be impossible in an anarchy, where each individual conducted his life in entire disregard of the needs of the larger group. Full creative life is equally impossible in a totalitarian government where all human activities must conform to a single central policy. In democracy alone, where freedom of thought is safeguarded and allowed expression in freedom of speech and of the press, and where, at the same time, freedom of action is, to the measure of the general good, controlled by the people themselves—in democracy alone may man evolve most freely. New thoughts can be tried out for their survival value in private schools and colleges, in cities and in states. It is these new ideas that constantly add to the richness of the nation and to the fullness of life of its citizens. Of course, in this very strength of democracy lies its weakness; this great and increasing diversity of life must be made sufficiently orderly to function and to protect the numerous minorities as well as the majority whose opinions dominate at the moment.

In the French Revolution the ideal was Liberty, Equality and Fraternity. At Gettysburg Lincoln reaffirmed that our nation was conceived in liberty and dedicated to the proposition that all men are created equal. These are the two eternally conflicting principles, liberty and equality. To make men and women equal in all things—houses, goods, education, length of working time—compulsion would be needed, an outside dictating authority. Some do not wish a college education, ideas of a desirable house differ. Some wish to carry business thoughts beyond the day into the night hours. To make all equal in all respects, regimentation would be required, and we would not have liberty. On the other hand, liberty for each to do as he wished all the time would interfere with the liberty of all the others, and hence there would result no equality. Yet the future of any nation depends upon these liberty-loving, mentally restless individuals. New application of well-known principles may be developed along directed grooves, but for the envisioning of new truths, the development of entirely new outlets for human energy, the individual must be free to think along any line and to try out these thoughts with his peers.

Democracy stands ideally for both liberty and equality with their unending conflict and unending readjustment. Democracy solves its issues by majority rule. At times this rule may be wrong, but experience and education can, through the pressure of a minority group acting on public opinion, bring about changes, because it is of the essence of democracy that smaller groups should, through freedom of speech and freedom of assemblage, have the opportunity to present their ideas before the groups that may at the time be dominant. It is a slow process, but the results are stable. Absolute truth in human affairs is not revealed to any one; it must be approximated through intellectual cooperation, and that means freedom of speech and of the press. It means a thorough appreciation of the dignity of the individual.

What definition of an ideal government could be more in conformity with the spirit of evolution than that given by Dorothy Thompson in her discussion of the meaning of democracy?

> Democracy for most of us is not an ism. It is a way of life. It does not represent any rigid form of state or national organization. It is something constantly developing and unfolding, changing from day to day, making mistakes, advancing in this direction and retreating in that, but always animated by a few fundamental ideas: that men have a right to live their own lives provided they don't tread too heavily on other people's toes; that the state is not endowed with any divine rights but is merely a useful instrument invented by men to serve them . . . that the individual shall be judged, not by his race, background or national origins, but by his human qualities of heart and mind and skill; that laws which every one must obey shall not be arbitrarily made but should be the result of debate, deliberation, consultation.

What better than democracy can aid the evolution of the life that for a million years on earth has been expressing itself in human form?

To briefly summarize: Through two billion years of evolution physical forms have been evolving. During the comparatively recent years of this evolution the human body has come into being, with its burden of animal appetites and instincts, with, in addition, its tool-making hand and its larger brain and nerve mechanism for conscious thought.

This animal, awaking into self-consciousness as man, finds that his life is the product of two sets of forces, first, forces outside himself, his environment inorganic and social, and second, forces within himself, the bundle of forces with which he is born, that constitute himself—the *body* with its appetites and needs and governed by a set of instincts, all inherited from a long line of animal ancestry, and that which takes *cognizance* of all this and knows that it is in control. Man wakes to find himself whirled through life, drawn by his appetites and emotions, but because he is man, the thinker, he realizes that it can be increasingly in his power to control these appetites and to some degree control the activities of his life.

He sees around him other thinking individuals, with the same instincts and emotions, linked with him in family, community, state and nation, each striving to live a full and safe, that is, a happy life. He sees other groups of individuals forming other nations of which the individuals also wish to lead happy lives. He shares with all the inheritance that accompanies the physical body, as, for example, such emotions as intolerance and belief in force; he finds that all are subject to the passions of the pack, as seen in mob violence and in heresy hunting spasms. Accompanying these impulses, he sees also emotions of a kindlier nature, sympathy, forbearance, protection of the weak, all growing out of the parental instinct. These, however, were evolved later in time than the preceding ones and are at times submerged by the older and hence stronger emotions.

In some nations he sees where certain groups have made use of force and intolerance to become supreme, with at times a single man becoming dominant over the thought and actions of a nation. In other nations he sees a frequent shifting of government, as one group after another succeeds in seizing control by armed force. And finally, he sees the nations in which control of any group is decided by majority vote.

As man views such democracies, he realizes that they are succeeding only because education is required of all, and because there is freedom through press and discussion for the expression of varying views. It is this accessibility to varying views and to consequent possible change that gives the democratic form of government the vitality of an evolving organism. Here may humanity find freedom for expansion in the limitless realm of the human spirit, new thoughts ever leading into new activities and a continually richer life. Expansion of consciousness in man can result only from such never-ending compromise between liberty for each and equality for all.

"HOW SOON WILL THE 'MANUAL' BE DONE?"[1]

A PLEA FOR SOME UNDISTURBED MOMENTS

By Professor MERRITT L. FERNALD
GRAY HERBARIUM, HARVARD UNIVERSITY

IN 1829, in edition 5 of his "Manual of Botany," Amos Eaton wrote: "Many vain botanists are continually in search of new species; and their vanity leads them into gross absurdities. . . . There is not [note the singular verb], probably, 50 undescribed species of Phenogamous plants in the United States—perhaps not one species east of the Mississippi." Amos Eaton believed in a simple system of classification, which still prevails in some centers, arranging his genera (without designation of families and orders) in strictly alphabetical sequence. In 1873, William H. Leggett, then editor of the *Bulletin of the Torrey Botanical Club*, wrote in volume iv (19, 20): "Many causes have led botanists in America to give their attention more particularly to the systematic part of the science; but this field has been so well worked, and is so full of workers, that there is little room for any new comer to add much to our knowledge."

Amos Eaton closed the door on further discovery of plants in the United States 109 years ago; Leggett again shut it 65 years ago. Nevertheless, here we are assembled as the American Society of Plant Taxonomists. In the southern idiom: "Wha' for are we all here?" Can it be that we are here simply because we are hungry?

I find myself retiring president of one of the least organized organizations in the country. When I was told that you had elected me your president, I was specially instructed that I must be wholly passive and "let George do it"; I was merely an ornament to be displayed at dinner after you had all presumably overeaten and were not too wide awake. In other words, the president of this organization without organization becomes the retiring president upon election. Retiring, according to the dictionary, means going out of sight or notice; shrinking from publicity; subdued.

There are advantages to these conditions. For instance, when the botanists planned to meet in Ottawa last summer I tried to make it clear that I could not be there, that my obligations in Cambridge and the special field-work I had undertaken in Virginia would make it out of the question. In the old days if one wished to become invisible it was necessary to go out in the moonlight on St. John's eve, and, while reciting the Pater Noster backward, to gather either the seeds of St. John's wort or "fern seeds." But now the process is more subtle. One needs to become a retiring president. At the time of the Ottawa meeting I was either in Cambridge or in Virginia (I haven't verified the dates). But as a retiring president (or one who shrinks from sight) I seem to have been present, though invisible, at Ottawa. I didn't know it myself; but the official report which I read in SCIENCE definitely stated that I was there and that I presided at one of the sessions.

But to come to the main theme. My text this evening will be found in the closing sentences of 999 out of every 1,000 letters which reach me:

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[1] Address of the retiring president of the American Society of Plant Taxonomists, Richmond, Va., December 28, 1938.

"HOW SOON WILL THE 'MANUAL' BE DONE?"[2]

Fully appreciating the interest of all of you in this vital topic, I am going to show you as briefly as possible why the conscientious writing of a manual is a slow and exacting task. It would be quite possible to hire an inexperienced clerk without too much knowledge of plants and to have him compile from the manuals of others a book which would look like Gray's "Manual." I realize that that is an up-to-date method of doing research and that some people applaud books thus produced; but I am old-fashioned and that is not my idea of a wholly satisfactory method of work. Conceptions of generic and specific lines vary. My own do not always coincide with those of some others; and the book I am trying to produce must be based upon my own studies and deductions. The period since Robinson and I transposed into the metric system the measurements in the sixth edition, shifted the nomenclature to meet the then current international rules, and revised the treatments of such groups as had already been revised, has been one of tremendous activity. The ghosts of Amos Eaton and of William H. Leggett would shrink into mere shades if they realized what has been going on. In my office there are card-catalogues of current items regarding range-extensions, nomenclature, technical characters, new discoveries and differences of opinion. Computing from the contents of one drawer, I estimate that these trouble-making card-catalogues contain 150,000 entries. Figuring that one half of these record differences of opinion, you can see what I am facing. The reconciling of 75,000 differences of opinion and the drawing from them of something resembling my own ideas is really some task! If one of the entries gets overlooked the whole book will be condemned. Nevertheless, working in those abundant moments of a teacher with a full quota of lectures; with a dozen or more tremendously diligent and earnest research students finding puzzles to be solved; with the monthly editing of a technical journal, most of whose authors want their data and statements verified by the editors; with a mail of 20 or more letters a day, each asking or claiming the individual judgment of the recipient on some question he knows nothing about (and some of the letters as appealing as the following: "Professor Gray Hibernian, Curate of the Garden, Boston. Dear Professor Hibernian: Our class has a project on the flowers of Massachusetts. Please send us on the inclosed sheet all you know about the above subject and oblige"); with daily packages of all the miscellaneous puzzles which have been given up in local herbaria over the United States and Canada; with semi-weekly second or third appeals for a brand new autobiography to be published in the indispensable "Who's Who in Ward 7" or in "The Lesser Men of Science"; with six-page questionnaires on every conceivable subject; with requests from *Chronica Botanica* for a list of every one of the thousands upon thousands of collectors represented in the Gray Herbarium with a biographical sketch of each one; all these in addition to the regular extra-classroom duties of a university professor and the director of an active research establishment—in this plethora of free time the treatment of 756 genera, containing 3,300 species and varieties, has already been completed; and the genera contain such nice little groups as *Panicum* and *Solidago*. This may seem like slow progress to those who believe that I should crib my treatment of *Astragalus* from Rydberg and of *Solidago* from Mackenzie. My treatments of these groups, however, are based on my own studies; I could not honestly accept the other treatments, *in toto*, as my own.

Unhappily, or perhaps happily, as soon as news leaks out (and it always leaks out, especially if it is groundless) that I have finally written up some group for the "Manual," large packages and freight-boxes begin to arrive, with the kindly and very complimentary request that I stop all other work and spend three weeks studying and labeling all material of *Solidago* or of *Xanthium* and then return it to the sender; the accompanying letter of transmittal always ending: "How soon will the Manual be done?" Every one who knows me will tell you that I have a one-track mind, of course with the network of usual side-tracks at all stations of one-track roads. Incidentally my memory for forgotten details is not perfect. As a typical Cape Codder once remarked to me: "I have a good memory; only it is terribly short." If I yield to my sympathetic impulses and hunt up the revisions of groups long forgotten, in order to be accommodating, progress along the main line is stopped. I wrote up *Panicum* with its 110 species and varieties in 1934, *Antennaria* with 42 and *Solidago* with 120 in 1935, the *Ranunculaceae* with 175 in 1936. Those stations were long since passed and all the freight then assembled in them taken aboard. If, when I am struggling in interrupted moments to classify for proper delivery in 1939 the confused freight at Dogwood and Willow-grove stations, I am pressed to back up to the side-track at Goldenrod Crossing, which was safely passed in 1935 and where no new freight has been delivered, I shall not get back on the single main track and reach Hawkweed station, at the end of the line, in time to deliver the freight there. You might suppose that a man who is approaching the age of second childhood would remember everything in the distant past; but, frankly, when my mind is closely absorbed in trying to untangle the intricately confused species of *Vitis* and endeavoring to discover really stable differential points, so that I can safely pass Grapevine Bower, or when I am trying to keep on the single track through the perpetually retarding thicket or brambles, my mind has become wholly blank regarding the finer details of *Rhynchospora* and of *Erigeron*, whose freights were long-ago checked off as safely on board.

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[2] Eighth edition of Gray, "Manual of Botany."

Another of the perpetual obstacles to rapid progress along the line is the confusing and slipshod rubbish which clutters the track. One illustration will show what I mean. In 1890 a lifelong student of pondweeds, aiming to name a specimen from Spallumacheen River, British Columbia, called it *Potamogeton pusillus*, "var. *elongatus*," giving little if any diagnosis. One year later, in 1891, he definitely described the British Columbian plant as var. *elongatus*. Ten years after it was cited formally by him as the type and only material of var. *elongatus* the Spallumacheen River plant figured, in 1901, as part of a second of the same author's varieties: "*P. pusillus*, var nov. *capitatus*. This was sent me by Professer Macoun from Sable Island [Nova Scotia], and I have also specimens from the Spallumacheen River, British Columbia, which I had wrongly referred to my var. *elongatus*." Just why "wrongly" does not appear, since the British Columbian plant was the type and only cited specimen of var. *elongatus*. The Sable Island plant is actually ordinary *P. pusillus*, var. *tenuissimus* Mert. and Koch., such as abounds in Canada and Eurasia.

In describing var. *capitatus* from Sable Island, its author said: "the fruit stems [whatever they may be] approach in character those of my *Potamogeton Aschersonii*" of Chile, thus starting further complications for the Sable Island plant. Var. *capitatus* had been given the highly impressionistic characterization "the heads of flowers at a short distance looking as though they are elevated above the plant without any peduncle." This is almost as definite as the same author's characterization of his *P. Sturrockii*: "Whole plant delicate, pellucid and not conforming to any named *pusillus*, but standing apart"!

Returning to *Potamogeton Aschersonii*, to which the Sable Island plant was said to be similar, *P. Aschersonii* from South America had a most extraordinary christening in 1893, said by the same English author to be a *pusilloid* species (*i.e.*, with narrowly linear leaves 0.1–5 mm broad); but its author said that its "linear" leaves were "1–3 in. long, 1–1½ inches broad. . . . Fruit 2¼ lines long, by 1⅓ inches broad." Obviously no plant with leaves 1–1½ inches broad belongs in the *Pusilli* (with leaves only 0.1–5 mm broad) and the fruits, described as being as broad as walnuts, are quite impossible in any pondweed. But when he suggested that the Sable Island plant, actually with leaves 1 mm wide and fruits 2 mm broad, belonged to the same group as *P. Aschersonii*, he started something. In 1916 a Swedish student of the group fell into the trap and definitely cited *P. Aschersonii* not only from South America, where it occurs, but from Sable Island as well.

Not only did the Swede so identify the Sable Island plant, the type of *Potamogeton pusillus*, var. *capitatus*, which was said by its own author to include his earlier-published var. *elongatus*, but it was also cited by the author of *P. Sturrockii* as that plant, the species which differs by "standing apart." To add to the dilemma we are seriously told that "Of a hybrid origin are, no doubt, the vars. *capitatus* . . . and *Sturrockii*." This is almost the last straw (the last straw will blow across our horizon later). Little *Potamogeton pusillus*, var. *tenuissimus*, of Sable Island is not only that variety, but it is said likewise to be *P. Sturrockii*, *P. Aschersonii* and *P. pusillus*, vars. *capitatus* and *elongatus* and it is also "no doubt" two different hybrids. As the only representative of the group known to occur on Sable Island it has accomplished wonders. At least ten times in as many years I puzzled over the complex situation above described (with further complications introduced by Graebner) and, after intensive study for days at a time, repeatedly abandoned the maze, lest I should reach the mental condition aptly described in 1847 by Asa Gray in a letter to Jane Loring, his prospective wife, who to two generations of students was affectionately known as Lady Jane Gray. Here is Gray's letter:

> I have been addling my brain and straining my eyes over a set of ignoble Pond-weeds (alias Potamogeton) trying to find the
>
> ''difference there should be
> 'Twixt tweedle-dum and tweedle-dee''
>
> and wasting about as much brain in the operation as your dear paternal would expend in an intricate law case, for all of which I suppose nobody will thank me and I shall get no fee. . . . But I shall be glad when they are done.
>
> 10:45 P.M. There, the Pond-weeds are done.

Now for the last straw. The meddlesome young botanists at the British Museum have just brought forward the assertion that the one and only specimen before Linnaeus in originally describing *Potamogeton pusillus* has never before been critically examined by a student of the group, although the famous English student of the genus above quoted had always lived within an hour's ride of it. It is not at all what every one calls *P. pusillus* but another species. Now we must start all over again! Yet some people argue that botany is an exact science; furthermore, they repeatedly ask, "How soon will the 'Manual' be done?"

Potamogeton pusillus is not the only plant of our flora of which the actual type, with which Linnaeus, Lamarck or Michaux worked, has been neglected. There are hundreds and hundreds of others. In that happy period when weight of authority and established usage were the law the old and historic specimens were of natural interest but not too binding upon the student. Now, with emphasis upon the historic type (beginning with 1753) and strict priority of publication the whole picture has changed. It becomes imperative that the groundwork of all our species be reinspected. This is slow and exacting work and too often there is difficulty in determining beyond dispute just which of several different elements should stand as the actual type. With the addition of these newly imposed burdens, the author of a manual which aims to be authoritative must be allowed some time in which to prosecute his exacting studies. If these unescapable studies are constantly retarded by the thoughtless and needless urging upon the author of too many axes to grind for others the question must inevitably arise: Which do eastern American botanists want done first, the "Manual" or its author?

OBITUARY

WILTON EVERETT BRITTON

1868–1939

A STERLING gentleman and an able scientist passed from life on February 15, 1939, with the death of Wilton Everett Britton, state entomologist of Connecticut and director of the State Geological and Natural History Survey. Few entomologists have had a more fully rounded career, and few have given so full a measure of unselfish service to their fellow workers and to the public.

Dr. Britton was the builder of the department of entomology of the Connecticut Agricultural Experiment Station. He lived to see his department housed in a building designed for biological research, and he gathered about him a staff of earnest and able men to carry on his traditions of quiet and thorough work. He took part in a score of activities relating to his scientific duties, and he exerted a wide and healthful influence.

Dr. Britton was born at Marlboro, Mass., on September 18, 1868. His early background, however, was rural, and his early years were spent on a farm in New Hampshire, near the city of Keene. In 1893 he received the degree of bachelor of science from the New Hampshire College of Agriculture and the Mechanic Arts, now the University of New Hampshire. In 1894 he was a graduate student at Cornell University. That same year he became a member of the staff of the Connecticut Agricultural Experiment Station, as horticulturist, and he continued as a servant of the state of Connecticut until his death. In 1901 he became state entomologist and entomologist of the experiment station. In 1925 he assumed the additional duties of director of the State Geological and Natural History Survey. On April 30, 1895, Dr. Britton was married to Bertha Madeline Perkins, of Surry, N. H. There were no children. In 1938, after a long illness, Mrs. Britton died. Two brothers and a sister of Dr. Britton survive him.

Two years after Dr. Britton became state entomologist of Connecticut he was granted the degree of doctor of philosophy by Yale University. Twenty-seven years later, in 1930, the University of New Hampshire conferred upon him the honorary degree of doctor of science.

The breadth of Dr. Britton's interest and activities relating to his profession is well evidenced by the memberships that he held in various organizations and the responsibilities that he discharged. Early in his work he became a member of the American Association of Economic Entomology, and he was elected president in 1909. He was associate editor of the *Journal of Economic Entomology* from 1910 to 1929. He assisted in preparing the indexes of *American Economic Entomology* covering the years 1905 to 1934. He was a fellow of the Entomological Society of America. For thirty-five years he was a member of the American Association for the Advancement of Science, and for thirty-three of those years he was a fellow. He was one of the organizers of the Eastern Plant Board and was president in 1936.

He was actively identified with the work of the Crop Protection Institute and for a period was a member of its board of governors. From its beginnings he was chairman of the Connecticut Tree Protection Examining Board. He was a member of the National Malaria Committee. His activities with various Connecticut associations included the Pomological Society, the Beekeepers Association, the Forest and Park Association, the Botanical Society, the Nurserymen's Association and the Vegetable Growers' Association.

Dr. Britton was deeply interested in books and their significance. He was a member of the Library Association of Connecticut, was director and president of the Donald G. Mitchell Library and for seven years was director of the New Haven Public Library. For twenty-seven years he was a director of the Young Men's Institute Library.

The breadth of his service is further indicated by the fact that he was twice president of the Edgewood Civic Association, was a member of the Governor's Foot Guard for three years, was a member of the

Grange for forty years, and was chairman of the Committee on Food of the New Haven War Bureau during the world war.

Dr. Britton began his professional work at a time when difficult insect problems were arising. Early in his career the San José scale was discovered in Connecticut. The gipsy moth presented further problems, both administrative and technical. It was followed by the Japanese beetle, the European corn-borer and the Oriental beetle. In addition came the task of organizing and administering mosquito control.

A long list of publications attest Dr. Britton's tireless professional activities. Outstanding among these are his thirty-eight annual reports on the insects of Connecticut, a comprehensive series of publications which are continually referred to by entomologists everywhere. Bulletins from his department of the experiment station include among others a plant pest handbook. Publications of the State Geological and Natural History Survey also are noteworthy, including a check list of the insects of Connecticut, a guide to the insects of Connecticut and monographs of the Euplexoptera and Orthoptera, the Hymenoptera, the Hemiptera and the Odonata. At the time of his death a monograph of the Diptera of Connecticut was being prepared. In addition to these various reports and bulletins, Dr. Britton was the author of many articles in farm papers and magazines.

Most of all, Dr. Britton was a helpful co-worker among entomologists, giving freely of his energies and always contributing the orderly judgment which was a part of his fine mental equipment. His service to his state was signally recognized on July 30, 1936, at the Farm and Home Week, when he was especially honored as a leader in agricultural and rural life.

W. C. O'KANE

UNIVERSITY OF NEW HAMPSHIRE

RECENT DEATHS AND MEMORIALS

DR. CHARLES RUPERT STOCKARD, professor of anatomy and head of the department at the Cornell University Medical College, died on April 7 at the age of sixty years.

DR. WILLIAM HALLOCK PARK, Hermann M. Biggs professor of preventive medicine at the New York University Medical School, formerly director of the Bureau of Laboratories of the Health Department of New York City, died suddenly on April 6 at the age of seventy-five years.

DR. JAMES CLIFTON EDGAR, emeritus professor of obstetrics at the Cornell University Medical College, died on April 7. He was in his eightieth year.

DR. WILLIAM C. THRO, from 1918 to 1937 professor of clinical pathology at the Cornell University Medical College, died on April 6. He was sixty-four years old.

DR. THOMAS S. BAKER, from 1922 to 1935, when he retired with the title emeritus, president of the Carnegie Institute of Technology, died on April 7 at the age of sixty-eight years.

ON the occasion of the celebration of the hundredth anniversary of the birth of Théodule Ribot, who played an important part in France in the establishment of a scientific psychology, a commemorative ceremony will be held in Paris in June. There will also be celebrated the fiftieth anniversary of the establishment of the chair in experimental psychology in the Collège de France, which was first held by Th. Ribot and later by Pierre Janet, and of the laboratory of physiological psychology at the Sorbonne, of which Dr. Alfred Binet was director.

SCIENTIFIC EVENTS

PATENT INQUIRY OF THE AMERICAN ENGINEERING COUNCIL

THE Executive Committee of the American Engineering Council at its meeting on December 8 accepted the invitation of the National Industrial Conference Board to undertake a factual inquiry into the American Patent System. The inquiry is to be conducted by a separate special staff employed under direction of the Patents Committee of the American Engineering Council. The inquiry is to be financed from funds outside the present income of American Engineering Council, which are being provided by the National Industrial Conference Board.

The announcement of the plan was made by the National Industrial Conference Board in the following statement:

> A comprehensive investigation of the whole patent problem has just been started by the National Industrial Conference Board, independent fact-finding organization of management and labor. Technical phases of the investigation will be supervised by the Committee on Patents of the American Engineering Council, while the economic aspects will be analyzed by the conference board's economists under supervision of Dr. Robert F. Martin, director of the Economic Research Division of the board. Much work on the patent situation has already been done by the American Engineering Council Committee under the chairmanship of R. S. McBride, consulting chemical engineer. The other members of the committee are James

H. Critchett, general manager, Union Carbide and Carbon Research Laboratories, Inc.; William M. Grosvenor, consulting chemist and factory engineer; Frank B. Jewett, president, Bell Telephone Laboratories; Warner Seely, secretary, Warner and Swasey Company, and Kenneth H. Condit, executive assistant to the president, National Industrial Conference Board. Close cooperation with other organizations concerned with this problem is assured through representation on their patent committees by members of the board's staff.

Every phase of the patent problem will be studied by the experts of the Conference Board and Engineering Council. Five main headings are included in the outline of the inquiry. Under the general topic "Invention," there will be a study of the origins of inventions and a review of independent and organized invention. Such matters as costs, types of invention, work on inventions, use of patents and foreign experience will also be covered.

Perhaps the most important subject of the five concerns the social and economic effects of invention. Under this heading the effects on consumers, labor, capital and management will be studied in detail.

A third heading covers an examination of the patent system itself and the functioning of the Patent Office. Consequences of the patent system as shown by stimulation of invention and discovery are covered in another section. The final heading includes a critical review of the functioning of the patent system and of current criticisms and proposed reform.

This cooperative undertaking makes possible the fulfillment of recommendations made for such a fact-finding study earlier presented by the Patents Committee of the American Engineering Council to the Annual Assembly in 1937 and 1938, and approved by that body. The Patents Committee, at a meeting held in New York on December 9, approved of a detailed plan of procedure, and one division of the work has already been started. It is hoped that the complete undertaking will be finished within twelve months and that factual sections of the inquiry can be released before that time.

THE BRITISH JOURNAL OF ENDOCRINOLOGY

THE British Medical Research Council has issued a statement calling attention to the fact that the large and rapidly increasing amount of published work on endocrinology by British investigators has, for some time past, made it desirable to bring together and to make available in a single British journal papers which are at present scattered among many different publications. It is pointed out that, though there may be doubts as to the desirability of any step which might seem to accentuate the division of the field of the medical and biological sciences into specialized departments and groups, the lack of a British journal specifically devoted to endocrinology leads to the overloading of journals having other and more general interests, and is producing a position of increasing difficulty for those who have work on endocrinology to publish, as well as for those who need ready access to the published work in this field. The editorial boards of a large number of British journals have been asked for their views on the matter and are, without exception, favorable to the foundation of such a journal.

A committee has therefore been formed for the promotion of a new journal to be called the *Journal of Endocrinology*, in the first instance to be published quarterly. The members of this promoting committee, who will act as a committee of management, are: Dr. P. M. F. Bishop, Professor F. A. E. Crew, Sir Henry Dale, Professor E. C. Dodds, Professor C. R. Harington, Professor G. F. Marrian, Dr. F. H. A. Marshall, Dr. A. S. Parkes, Dr. F. G. Young and Dr. S. Zuckerman. They have appointed Professor E. C. Dodds as editor, to be assisted by an editorial board consisting of Dr. P. M. F. Bishop, Professor C. R. Harington, Dr. A. S. Parkes, Dr. F. G. Young and Dr. S. Zuckerman. Dr. R. L. Noble has been appointed assistant editor.

The scope of the *Journal of Endocrinology* is defined as the publication of communications which advance knowledge concerning the internally secreting glands, the mode of their actions, the nature of their secretions and the disorders of their functions.

TOUR OF THE INDUSTRIAL RESEARCH INSTITUTE

A TOUR of industrial research laboratories for members and guests of the Industrial Research Institute will precede a two-day convocation in the building of the National Academy of Sciences in Washington, has been announced by Maurice Holland, executive officer for the institute.

The institute, an affiliate of the National Research Council, will begin its visit to industrial laboratories on Tuesday, May 16, and will conclude the trip with a luncheon at the Hotel Mayflower in Washington on Saturday, May 20.

The group will assemble on Tuesday, May 16, at Canton, Ohio, where the first visit of the four-day trip will be at the laboratories of the Hoover Company. H. Earl Hoover, vice-president of the Hoover Company, is vice-chairman of the institute. From Canton the party will proceed to Pittsburgh, where they will make an all-day inspection of the laboratories and plant of the Jones and Laughlin Steel Corporation. The host there will be H. W. Graham, chairman of the executive committee of the institute, and chief metallurgist for the Jones and Laughlin Steel Corporation. The value of research in the steel industry is being determined by practical results in the pilot plant research and development laboratories at the Jones and

Laughlin Steel Corporation, which the visitors will view.

On May 18 the party will visit the laboratories of the Hercules Powder Company, at Wilmington, Del., where O. A. Pickett, director of the Experiment Station, will personally direct the tour of inspection.

The party will reach Washington on Thursday night, May 18, remaining there on Friday and Saturday, May 19 and 20. The two-day technical meeting of the institute will be held in the building of the National Academy of Sciences, where the members will be welcomed by Dr. Albert L. Barrows, executive secretary of the National Research Council.

The American Express Company is in charge of travel arrangements for the laboratories tour.

The membership of the institute is made up of executives in charge of research laboratories for small and large industries in the United States. It was formed a year ago "for cooperative study of the members' common problems of research management, for mutual criticism, exchange of ideas in an effort to bring about constant improvement of laboratory management."

AWARDS OF THE LALOR FOUNDATION

THE Board of Trustees of the Lalor Foundation has announced five awards for research in chemistry for the academic year 1939–40. These awards, which are for $2,500 each, are designed to enable men of outstanding ability to carry on special investigations at research centers of international importance. The recipients of the awards were chosen from a group of fifty-one candidates representing applicants working in the major fields of chemistry and related sciences.

The applications received indicate a wide-spread interest in these awards, 40 per cent. having come from candidates from universities in the eastern United States, 30 per cent. from the Middle West, 5 per cent. from the South, 15 per cent. from the Far West and 10 per cent. from candidates outside the boundaries of the United States.

As respects institutions where applicants elected to carry on their research, 50 per cent. selected eastern universities, 10 per cent. middle western institutions, 7 per cent. the Far West, 25 per cent. chose English universities, none selected Germany and 8 per cent. selected other European continental institutions.

The recipients of the awards are:

DR. OTTO KARL BEHRENS, of the Rockefeller Institute of New York, to work with Dr. D. Keilin, of the Institute of Biochemistry, Cambridge, England, on the chemistry of peptide metabolism in tissue slices.

DR. ANDREW CALVIN BRATTON, instructor in pharmacology at the Johns Hopkins University Medical School, to continue work with Dr. E. K. Marshall on chemical aspects of chemotherapy of compounds of the sulfanilamide type.

DR. ROBERT BYRON JACOBS, of the Research Laboratory of Physical Chemistry of the Massachusetts Institute of Technology, to continue work with Dr. F. G. Keyes on the fundamental properties of materials at low temperatures.

DR. WILLIAM EARL ROSEVEARE, assistant professor at the University of Wisconsin, to work with Dr. Henry Eyring at Princeton University on the determination of intermolecular forces in binary gaseous mixtures.

DR. CHARLES E. WARING, assistant professor at the Brooklyn Polytechnic Institute, to work with Dr. C. N. Hinshelwood at the University of Oxford on the kinetics of decomposition of silicon alkyl compounds.

The selection committee acting for the foundation consisted of Dr. Roger Adams, director of the Department of Chemistry of the University of Illinois; Dr. Hans T. Clarke, professor of biochemistry, Columbia University; Dr. Charles A. Kraus, of Brown University, president of the American Chemical Society; Dr. Arthur B. Lamb, director of the Division of Chemistry of Harvard University, and C. L. Burdick, secretary of the Lalor Foundation.

CELEBRATION OF THE SIXTIETH BIRTHDAY OF ALBERT EINSTEIN

THE sixtieth birthday of Albert Einstein, which occurred on March 16, was marked by a special radio program from Oakland, Calif., in which Professor J. Robert Oppenheimer spoke as follows:

This program is in celebration of the sixtieth birthday of Albert Einstein. His name is perhaps more widely known than that of any other living scientist; and to many millions of people it has come to stand for science itself, and for all that we admire in the way of life and thought of the scientist.

Most of us who are concerned with research in one or another branch of scientific work, are proud to have in Einstein a popular symbol of what we are doing and trying to do. Few men have contributed so much to our understanding of the Physical World, to our ability to predict and follow and control its behavior. And we see in Einstein, especially those of us who have come to know him a little, all those personal qualities that are the counterpart of great work: selflessness, humor, and a deep kindness.

But if few scientific workers would quarrel with the fact that Einstein is in many ways a perfect symbol of their work, there are many who would feel that there is something a little false and fabulous in the way he is thought of. There was a fable at one time that there were only a dozen men who could understand what Einstein had done; there is certainly a general impression, supported in part by his eminence, that his work has been qualitatively different from that of his fellow workers; that it is abstruse, and remote, and useless. This seems to me a very strange ground for admiration. And of course it is not true; and the truth is much better than the fable.

All discoveries in science grow from the work, patient and brilliant, of many workers. They would not be possible without this collaboration; they would not be possible without the constant technological developments that are necessary to new experiment and new scientific experience. One may even doubt whether in the end they can be possible except in a world which encourages scientific work, and treasures the knowledge and power which are its fruits.

For science is not parasitic on society: it makes a good return. And it is for its return, and not its abstruseness, that our children, when they learn of Einstein's work in college or in school, will prize it. It will be part of their thought, as for us to-day the work of Newton and of Pasteur; they will be able to trace its history in the development of countless new and powerful technological methods. In fact it was some of the early work of Einstein on the theory of relativity that first pointed the way to vast and hitherto untapped sources of energy. We know now that most of the sun's heat comes from these sources. And it is one of the most spectacular projects of contemporary atomic physics to make this energy available terrestrially, and thus to solve as far as human wants are concerned the problem of mechanical and electrical power. One could multiply instances of the usefulness, in the most direct and immediate sense, of Einstein's discoveries. But in every case we would find their development so closely interwoven with the work of countless other scientists and technicians that there would seem something artificial to such an analysis, and we would come away with only a deepened conviction of the cooperative and interrelated character of scientific achievement. And if we were to trace the effects of any great scientific discovery on human thought and culture, we should find a similar story.

It seems appropriate, on Einstein's sixtieth birthday, to speak of these simple things with a certain seriousness, for we know that he himself has been led to question the possibility of continued scientific progress in a world dominated by fascism and by fascist thought. We may be sure that it is not the special persecution to which he has been subject which has raised these grave doubts. It is a deeper thing. For it would seem that in a fascist world neither the technological nor the cultural fruits of science could find anything but abuse. For technology, by rendering less desperate the struggle for an adequate and rich existence, should tend to reduce and not increase the exploitation of man by man and of nation by nation. And in general the effect of science is to reduce too the absoluteness of the differences between people, and to increase their common understanding: that is just the content of its objectivity.

There are surely graver reasons for concern in the contemporary world than this threat to the future of science. But I doubt whether to-day there can be any better way to honor Einstein than to commit ourselves to the kind of world in which such work as his can be possible.

SCIENTIFIC NOTES AND NEWS

DR. SAMUEL C. LIND, dean of the Institute of Technology of the University of Minnesota, previously director of the School of Chemistry, has been chosen president-elect of the American Chemical Society.

A MEETING of the Harvey Cushing Society in honor of the seventieth birthday, on April 8, of Dr. Harvey Cushing, Sterling professor of neurology emeritus at Yale University, was held in New Haven on April 7. The speakers included Dr. Walter Freeman, professor of neuropathology at the George Washington University; Dr. James W. Watts, of the department of neurosurgery at the Hospital of the University of Pennsylvania, and Dr. Tracy J. Putnam, professor of neurology at the Harvard Medical School.

MERRITT L. FERNALD, Fisher professor of natural history and director of the Gray Herbarium of Harvard University, has been elected an honorary member of the Nova Scotian Institute of Science in recognition of his work on the flora of the Maritime Provinces.

AT the annual meeting of the Philadelphia College of Pharmacy and Science held on March 27, Dr. Wilmer Krusen, formerly director of public health of Philadelphia, was reelected president for the thirteenth time.

PROFESSOR FRANK E. RICHART, professor of engineering materials at the University of Illinois, was elected president of the American Concrete Institute at the recent annual meeting in New York City.

Nature states that at the annual general meeting of the Ray Society, London, held on March 23, the following officers were reelected: ***President,*** Sir Sidney F. Harmer; ***Treasurer,*** Professor F. E. Weiss; ***Secretary,*** Dr. W. T. Calman. Dr. John Ramsbottom was elected a vice-president.

DR. FRANKLYN BLISS SNYDER, professor of English, vice-president and dean of faculties of Northwestern University, has been elected eleventh president of the institution. Dr. Snyder, who has been associated with the university for thirty years, will succeed Dr. Walter Dill Scott, who has been president since 1920. Dr. Scott joined the university in 1900 as instructor in psychology and pedagogy and later became professor of psychology and director of the Psychological Laboratory.

DR. ROBERT A. MOORE, assistant professor of pathology at the Cornell University Medical College, has been appointed Edward Mallinckrodt professor of pathology and head of the department at Washington

University, St. Louis. Dr. D. K. Rose, associate professor of genito-urinary surgery, has been made full professor and head of that division in the department of surgery, and Dr. Felix Deutsch, a member of the faculty of the University of Vienna from 1919 to 1935, has been made associate professor of psychosomatic medicine.

DR. HAROLD C. UREY, professor of chemistry at Columbia University, has been appointed executive officer of the department of chemistry for a term of three years beginning on July 1. He will succeed Dr. Henry C. Sherman, Mitchill professor of chemistry, who has been head of the department for the last twenty years. Dr. Sherman will devote his time to research and teaching. Dr. J. Enrique Zanetti, professor of chemistry, has been named to the newly established position of director of laboratories.

RETIREMENTS from the faculty of the Johns Hopkins University have been announced as follows: Dr. Dean DeWitt Lewis, professor of surgery and surgeon in chief, the Johns Hopkins Hospital; Dr. Edward Bennett Mathews, since 1917 professor of mineralogy and petrography, and Dr. Thomas S. Cullen, since 1917 professor of gynecology. Each of them will receive the title of professor emeritus.

PROFESSOR WERNER HEISENBERG, of the University of Leipzig, will be visiting professor at Purdue University from July 1 to July 22 during the summer school session. He will lecture on problems of nuclear physics and cosmic rays.

DR. ROBERT HEGNER, professor of protozoology at the Johns Hopkins University, has accepted an invitation from the Department of Public Health of Mexico to help to organize a new Research Institute of Hygiene and Tropical Diseases, for which a building has been erected in Mexico City. He will sail on April 20 and return late in September. Dr. Redginal Hewitt will accompany him, and later in the season Marion Brooke will spend several months working at the institute under Dr. Hegner's direction.

DR. JOHN T. KING, associate in medicine of the School of Medicine of the Johns Hopkins University, was recently appointed physician-in-chief of the Baltimore city hospitals, filling the vacancy caused by the death of Dr. Thomas R. Boggs.

DR. P. N. ANNAND has been appointed assistant chief of the Bureau of Entomology and Plant Quarantine of the U. S. Department of Agriculture, effective on April 1. Since September, 1937, he has been a special assistant to the chief of the bureau on matters relating to research. He will continue to give special attention to the integration and planning of the research work.

DR. GEORGE S. STEVENSON, for twelve years director of the Division of Community Clinics of the National Committee for Mental Hygiene, has been appointed medical director, succeeding Dr. Clarence M. Hincks, who has asked to be relieved of the work, except as part-time field consultant, in order that he may give more time to the work of the National Committee for Mental Hygiene of Canada, of which he is the general director and founder. H. Edmund Bullis, who has served as executive officer of the National Committee and as assistant to Dr. Hincks, continues on the staff as part-time business manager.

ROBERT E. ADAMS, a recent graduate of the University of Wisconsin, and W. G. N. Heer, graduate in metallurgy of the University of Alabama, who was previously associated with the Tennessee Coal, Iron and Railroad Company, have been appointed members of the technical staff of the Battelle Memorial Institute, Columbus, Ohio. Both have been assigned to the process metallurgy division.

PROFESSOR JOHN S. DODDS, chairman of the American Engineering Council Committee on Surveys and Maps, has been appointed a member of the Advisory Council of the Federal Board of Surveys and Maps.

Nature states that J. E. Montgomrey has been appointed secretary of the British Institution of Mechanical Engineers in succession to Brigadier-General Magnus Mowat, who has retired on account of ill health. Mr. Montgomrey has been assistant secretary of the institution since 1920.

THE British Minister of Health has appointed a number of consultant advisers on the organization of hospitals in England and Wales in war-time. These advisers, who were nominated by the presidents of the Royal Colleges of Physicians and Surgeons, are Dr. Gordon Holmes, neurology; Dr. Bernard Hart, psychiatry; Dr. Gwynne Williams, orthopedic surgery; Sir Cuthbert Wallace, general surgery; Sir Harold Gillies, facial and jaw injuries; Dr. A. Tudor Edwards, chest wounds; Professor Hugh Cairns, head injuries; Professor F. R. Fraser, general medicine; Dr. W. M. Mollison, ear, nose and throat; Dr. C. B. Goulden, ophthalmology, and Dr. A. E. Barclay, radiology.

THE Medical Research Council of Ireland has awarded a grant for one year's training in methods of research on hormones to Dr. T. E. T. Bradshaw and a whole-time grant for one year to carry out serological research in the department of bacteriology, Trinity College, Dublin, to Professor Hans Sachs. Grants-in-aid of research expenses have also been made to Professor T. W. F. Dillon, Professor J. F. Donegan and Dr. Patrick FitzGerald. The grants made to Dr. J. C. Flood, Dr. R. A. Q. O'Meara and Dr. J. C. Shee have been renewed.

PROFESSOR BERGEN DAVIS and Professor Daniel D.

Jackson, of the department of physics of Columbia University, have leave of absence for the present semester.

Dr. Jonas Borak, of Vienna, the radiologist, who has been invited to give a number of lectures at New York University, arrived in New York on April 6.

The Acoustical Society of America will celebrate the tenth anniversary of the founding of the society on May 15 and 16. A symposium is planned on "The Measurement and Application of Absorption Coefficients." There will also be a program of technical papers, which will include a paper entitled "A Demonstration of Combination Tones," by Sir William Bragg, of the Royal Institution, London.

Dr. William deB. MacNider, Kenan research professor of pharmacology in the Medical School of the University of North Carolina, delivered a Mayo Foundation lecture at Rochester, Minn., on March 17.

The eighth annual series of addresses under the auspices of the Benjamin Knox Rachford Lectureship will be given at the Children's Hospital Research Foundation, Cincinnati, Ohio, by Dr. Ernest W. Goodpasture, professor of pathology at Vanderbilt University. The subjects of the lectures will be: "Experimental Virus Infections of the Chick Embryo" and "Experimental Bacterial Infections of the Chick Embryo."

Dr. Frederick F. Russell, professor of preventive medicine and epidemiology, emeritus, of the Harvard Medical School, will deliver the annual Cutter lecture in preventive medicine on April 17. His subject will be "The History of Yellow Fever as an Illustration of Methods of Study and Control of Virus Diseases."

Dr. C. H. Danforth, professor of anatomy at Stanford University, will deliver the seventh Harvey Society lecture of the current series at the New York Academy of Medicine on April 20. He will speak on "Genic and Hormonal Factors in Some Biological Processes."

Dr. René Leriche, professor of chemical surgery at the University of Strasbourg, delivered the Lister Memorial Lecture before the Royal College of Surgeons of England on April 5. The lecture was entitled "The Listerian Idea in the Year 1939."

A new series of short courses in science is announced by the American Institute, New York City. Dr. M. L. Crossley, director of research of the Calco Chemical Company, will lecture on "Sulphanilimide and its Compounds." His lectures were announced for April 11, 18 and 25. The dates of lectures by Dr. Oscar Riddle, of the Station for Experimental Evolution at Cold Spring Harbor, Long Island, on "The Endocrine Glands" are April 13, 20 and 27. The lectures will be given at 7:30 p.m. at the meeting rooms of the institute, 60 East 42d Street, New York City.

The Royal College of Surgeons, London, has appointed Sir James Walton Bradshaw lecturer and Sir Walter Langdon-Brown Vicary lecturer for the coming year.

The forty-fourth annual meeting of the Michigan Academy of Science, Arts and Letters was held on March 9, 10 and 11. Included in the program were addresses by Professor Arthur E. R. Boak, president of the academy, and by Dr. George H. Whipple, dean of the School of Medicine and Dentistry of the University of Rochester. Professor Boak spoke on "The Rôle of Taxation in the Decline of the Roman Empire," and Dean Whipple on "Anemia and the Building of Hemoglobin in the Body." Two hundred and ninety-four special papers were included in the program.

The Dutch Congress of Natural Science and Medicine was held at Nymwegen, under the presidency of Professor G. Holst, from April 11 to 13.

An extensive program is being developed for the 1939 World Engineering Congress of the Society of Automotive Engineers. Some sixty technical papers by well-known authorities are given on the preliminary program; over one third of the speakers are Europeans. The congress opens on May 22 in New York for a five-day session, will be in Indianapolis from May 29 to 30, in Detroit from May 31 to June 2 and closes with a three-day session in San Francisco, ending on June 8. Advanced engineering design problems of aircraft, automobile, trucks, buses, railcars, the rôle of tractors in our national economy, operating problems of fleet owners and reports on fuels and lubricants developments will be covered by the congress.

The University of Pavia arranged a celebration in honor of the eighteenth-century physiologist, biologist and vulcanologist, Spallanzani (1729–1799), which was held in Pavia from April 11 to 14. According to *Nature*, a monument to Spallanzani was unveiled and a program of scientific addresses, mainly on modern genetical problems and the physiology of reproduction, was presented by delegates invited from various countries, including from Great Britain Professor R. Ruggles Gates, Professor F. A. E. Crew and Dr. C. F. Pantin. Meetings of the societies for experimental biology, botany, geology and veterinary medicine are also being held at the university, and a visit will be paid to the Spallanzani Museum at Reggio Emilia.

Museum News states that a survey of the exhibits at the world's fairs at New York and San Francisco will be made by internes in training at the Buffalo Museum of Science under Carlos E. Cummings, director, in cooperation with Robert P. Shaw, director of the New York Museum of Science and Industry. The internes will make an analysis of each exhibit, covering such items as the use of light and color, sound effects, labels, leaflets and folders, attendants and visitor participation and flow. An endeavor will be made also to list exhibits that might be suitable for museum use after the fairs. The Rockefeller Foundation has made a grant for preparing a report. The American Museum of Health, New York, has received a grant from the Carnegie Corporation of New York for a study of the reaction of visitors to the museum's medical and public health exhibit at the New York fair. The study will be directed by Dr. Mayhew Derryberry, of the U. S. Public Health Service.

DISCUSSION

DISEASE, DAMAGE AND POLLINATION TYPES IN "GRAINS"

American students of plant diseases for over half a century have been more concerned with the organisms causing disease, especially fungi, than with the host plants. No doubt the present interest in plant breeding will tend to readjust the balance. But even to-day interest in virus diseases centers rather on the nature of the viruses than on their effects. In particular, any attempt to generalize as to the disease relations of groups of plants has been almost wholly lacking from our literature. Hartley's[1] discussion of the disease hazards incident to planting clonal varieties of trees is a conspicuous exception. He notes that "The expectation that genetic uniformity will favor the building up of specialized strains of parasites is supported by practical experience with such clonal cultures as Lombardy poplar avenues, rubber plantations, fruit trees, roses, potatoes, bananas, sugar cane and the creeping-bent golf-green grasses." The present paper is an attempt to examine some of the available evidence in order to determine whether such a relation is observable among major crop plants.

That numerous biological strains of many parasitic fungi exist in nature and that they vary continually through crossing and otherwise has been abundantly demonstrated in recent literature. Some of our crop plants, on the other hand, because of the method used in propagation or their own floral characteristics, have very much less natural opportunity for variation and adaptation than others. It seems probable that in their long-continued mutual association, parasites might well obtain a relatively greater advantage over those host plants which themselves had the least capacity for variation and adjustment. This might express itself in greater disease losses over a period of years or, in the case of parasites particularly favored by special environmental conditions, it might express itself in epidemics in the relatively weaker groups of host plants.

As to the capacity of the host to vary and adjust itself, vegetatively propagated plants would be less efficient than those produced from seed. Among plants grown from seed there would be a gradation in this respect from plants largely self-pollinated, to plants with perfect flowers which are usually cross-pollinated, then monoecious and finally dioecious or heterostylous plants. Of course, no such complete series exists among comparable crop plants, but those commercially classed as "grains" offer some interesting contrasts.

In an attempt to evaluate disease losses in the United States as a whole, one naturally turns first to the estimates of diseases losses compiled by the Plant Disease Survey. These have, however, been systematically collected for only twenty years and suffer, to some extent, from the lack of regular reports from many states. In fact, there are no subjects on which present-day plant pathologists are more reluctant to express an opinion than the extent of crop losses from disease and the economic importance of plant diseases. These are obviously not the same thing. Economic importance, while difficult to measure, must be in some way a function of the value of the crop concerned, the loss caused by disease and the fluctuations in loss. This last is a very important consideration. Other things being equal, even the average losses over a period of years, that disease is the most important which fluctuates most. Secretary Wallace has said, "Fluctuations in yields cause as much embarrassment as unbalanced acreage."[2]

In searching for some means of measuring the relative importance of diseases of economic plants, it dawned upon me that volume of publication must, in some degree at least and for the more important crops, express the opinion of plant pathologists and others interested as to the importance of diseases.

I have accordingly tabulated the total pages regarding the diseases of various important crops in the publications of the U. S. Department of Agriculture up to January, 1925, of the Experiment Stations up to December 1, 1927, and in *Phytopathology* up to January, 1927. This covers, for the experiment stations, a period of 40 years and, in the case of the

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[1] Carl Hartley, *Phytopathology*, 29: 9, 1939.

[2] *New Republic*, December 2, 1936.

Federal Government, goes back even before the Department of Agriculture was organized and includes some publications of the Commissioner of Patents. My reason for stopping at a point over a decade ago is that these are the dates of the excellent bibliographies compiled by Miss Jessie Allen, librarian of the Bureau of Plant Industry. In the introduction to one of these, Miss Allen states that, "Some appraisement has been made for subjects upon which there are many contributions, the brief and less important ones being omitted. For subjects on which there are few publications all have been included." Thus any error in the figures is in increasing their size for the less important crops or diseases.

Obviously such a means of measuring the importance of plant diseases can have no validity in the case of many small and highly specialized crops where the publications of a small group of enthusiastic workers or even one investigator—or for that matter a single paper—easily assume undue importancce. Nor could we expect to compare too closely, succulent vegetables with grains. But it may be possible to obtain a measure of the apparent relative economic importance of diseases in the culture of crops which have a not too widely different value per acre, are marketed in somewhat the same way, and produced by more or less comparable groups.

Such a unit is apparently found in the crops classed together as "grain crops" for statistical purposes in the publications of the U. S. Department of Agriculture. For such crops this means of measurement must have real significance, unless there has been something radically wrong with the administration of plant disease work in this country over a period of half a century. Most of this work has been tax-supported and the obligation to see that most of the money was spent where most needed must have been generally recognized. Indeed, it would probably have been enforced by popular pressure.

If such figures are to be used as a means of evaluating the relative importance of diseases in different crops, some adjustment must be made for the value of the crop; the most obvious method seems to be to divide the number of pages published by the value of the crop concerned in millions of dollars. This has been done, using the average value of the crop for the ten-year period 1910–1919 as a basis of computation. Several other periods were tried with no difference in the order of the various crops. Some of the results of this summary are given in Table 1.

For comparison with these crops, it may be noted that the disease indices computed on the same basis for grapes and the important tree fruits—all vegetatively propagated—are over 30 and that for potatoes over 20.

TABLE 1

RELATIVE ECONOMIC IMPORTANCE OF DISEASE IN VARIOUS "GRAINS" AS INDICATED BY VOLUME OF PUBLICATION IN U. S. A.

	Total pages	Disease index (corrected by value of crop)
Flax	426	14.2
Rice	205	4.9
Barley	526	3.5
Wheat	3526	3.4
Sorghum	305	2.3
Oats	1178	1.8
Rye	94	1.5
Corn	1941	0.8
Buckwheat	0	0

Whatever may be one's opinion of the validity of this method of appraising the importance of diseases in the culture of a crop, there are probably few who will take exception to the fruits being placed far above the grains in this respect or to the order of most of the "grain" crops in the table.

In this it is at least worthy of comment that the highest six are largely self-pollinated under natural conditions, rye and corn chiefly cross-pollinated, and buckwheat heterostylous and thus always cross-pollinated.

There can be no point in emphasizing too much the fact that at least up to 1927 no single page had been devoted to diseases of buckwheat in the literature reviewed. Indeed, the only reference to the subject found so far is the statement in Robbins and Ramaley's text,[3] "It is singularly free from insect pests and fungous diseases." To be sure, buckwheat is not a major crop, nor on the other hand is it negligible. Its average farm value per year for the period 1910 to 1919 was over 16 million dollars, and in 1920 the farm value of the crop in New York State was over 6 million. Serious epidemics of disease in crops valued at 6 millions have not gone unnoticed in New York State during the past 25 years.

Any one who is unwilling to accept the significance of a correlation between the striking freedom from disease and the fact that the plant can reproduce only by crossing (a condition comparable to that in all the higher animals) should at least advance some other hypothesis.

NEIL E. STEVENS
UNIVERSITY OF ILLINOIS

ARTIFACTS IN CANADIAN RIVER TERRACES

ARCHEOLOGY frequently yields finds tantalizing in their incompleteness and implications, which do little more than point the way for future work. It is in this class that we must place the few rough artifacts found this past summer in the terraces of the North Saskatchewan and Peace rivers, in Alberta.

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[3] "Plants Useful to Man," p. 184.

Along the North Saskatchewan, about three miles southwest, or up river from Edmonton, are the gravel pits from which are taken much of the road and construction gravel used in the city. Reports of the occasional occurrence of bones in the gravels prompted an examination which resulted in the recovery of eight more or less fragmentary and waterworn unfossilized horse bones of a large and a small species, a section of unidentified antler and several artifacts. With one exception the bones had been removed by the workmen, who report that they are found haphazardly scattered at any depth in the gravel, apparently none of them articulated.

The artifacts found *in situ* in the pit walls consist of a large quartzite core, two large quartzite flakes, one seemingly retouched into a rough sidescraper, and pieces of petrified wood and chalcedony. The core lay near the bottom of a gravel-streaked clay pocket in the terrace surface, the other pieces in the upper portion of the gravel. Professor P. S. Warren, of the department of geology, University of Edmonton, kindly inspected them before they were moved and agreed that they were not intrusive; that the overlying material indicated that they had been buried by the action of the river while it was still at the level of this terrace. Apparently, the natives had sought stones suitable for tools and weapons at periods of low water, the scrap material left behind being covered by subsequent flooding. A search of the loose, disturbed gravel produced two roughly flaked waterworn quartzite cobbles and several questionable pieces.

In his study of the glaciation of this area Professor Warren has prospected the source of the terrace gravel, an exposed bank of boulder clay capped with glacial lake silt, for bones or fossils. He has seen nothing to indicate that the bones commonly found in the gravel were derived from that source, which may mean that they are remains of animals dying in the valley at the time the terrace was forming.

At present we have no means or data for computing the age as indicated by the change in river level, a drop of about eighty-five feet (measurement by aneroid).

A similar situation apparently exists along the Peace River. In the course of railroad and highway construction a large pit has been excavated in an old terrace, one hundred feet above present water level, at the west end of the bridge crossing from the town of Peace River. Unfortunately, the three or four roughly flaked waterworn quartzite cobbles which can be classed as artifacts were all found in loose or disturbed gravel; their association with the formation depending partly on their condition. The one bone secured, a metatarsal, is from an animal comparable in size and form to *Cervus canadensis,* and was down about eighteen feet in the gravel.

Although these things tell us nothing of the former inhabitants of Alberta, they do help to define the ground where we may ultimately find their history.

JUNIUS BIRD

AMERICAN MUSEUM OF NATURAL HISTORY

A NEW OUTLINE MAP OF NORTH AMERICA FOR PHYTOGEOGRAPHERS

DURING the preparation of a series of distribution maps showing the geographical ranges in North America of several hundred species of bryophytes, some of nearly all the available outline maps issued by various publishers were tried out, one after another. Each one of them was found to be unsuitable in some way, at least for my purposes. The map which was most nearly satisfactory, and which was found to reproduce very well, was one lithoprinted in Ann Arbor as No. 21B in "The Geographical Institute's Series of Maps and Graphs," under the sponsorship of Professor Robert B. Hall, of the department of geography, University of Michigan.

As this map went out of print just as it was becoming most useful to me, Professor Hall very kindly agreed to prepare a map specifically designed to meet my needs and those of phytogeographers in general. For help and advice in the selection of what such a map should show, I am very grateful to many botanists, especially H. H. Bartlett, E. T. Wherry and F. J. Hermann; also to G. M. Stanley, of the department of geology, University of Michigan.

The new map has just appeared as "North America—205C" in "Hall's Series of Maps" published by John Wiley and Sons. It is printed from copper plates on 8½ × 11 inch stock and presents a combination of features of various kinds not found on other outline maps. For instance, the Aleutian Islands and the Lesser Antilles both appear, as well as the entire Arctic American Archipelago and all Greenland (Bonne's projection). With the exception of the Arctic Circle and the Tropic of Cancer, which are indicated separately, latitude and longitude are indicated at ten-degree intervals. The most important drainage systems are shown, yet not enough in detail to clog when the map is reduced one half to two thirds in publication. Further features, very important in the light they shed on geographic distribution of plants, are (1) the Fall Line (after Loomis[1]), (2) the total extent of Pleistocene glaciation (after Antevs[2] and Daly[3]) and (3) the maximum extent of the Wisconsin stage of the Pleistocene in eastern North America (after Leverett and Taylor,[4] Leverett[5] and Antevs[2]).

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[1] F. B. Loomis, "Physiography of the United States," viii + 350. New York, 1937.

[2] E. Antevs, *Bull. Geol. Soc. Amer.*, 40: 631–720, 1929.

[3] R. A. Daly, "The Changing World of the Ice Age," xix + 271. New Haven, 1934.

[4] F. Leverett and F. B. Taylor, U. S. Geol. Surv. Monogr. 53. Pp. 1–529. Washington, 1915.

[5] F. Leverett, *U. S. Geol. Surv. Prof. Paper* 154-A: 19, Fig. 5, 1929.

In its preparation, the new map was designed not only for manuscript notes, but for reduction to at least half-size in publication, and full permission is generously given by Dr. Hall and the publishers for the reproduction of this map to illustrate geographical distribution of plants (or animals) in scientific publications.

WILLIAM CAMPBELL STEERE
UNIVERSITY OF MICHIGAN

MECHANICS OF INDEXING

THE "Easier Method for Making an Index" (SCIENCE, March 10) is extremely rapid and simple in comparison with the method described in the issue of January 20, but it involves perforated sheets, which are not always available; tearing off the slips takes time, and perforated edges do not facilitate filing. In this department we have used a slightly different method. Typewriter paper is marked off in rectangles, ten of which may be used on a sheet if entries are brief. After writing a few sheets, the typist becomes familiar with the spacing, and guide lines are unnecessary. When the typing is completed, all the sheets, whether 50 or 500, are sheared (in one operation) with a paper cutter to the dimensions of the original guide lines. This procedure was used here in 1936 in indexing a bibliography ("Non-Metallic Inclusions . . ." by McCombs and Schrero) with 2,136 items, and three or four times that number of entries in the index.

For an index which is to be printed, rather heavy paper should be used. A compositor expects his copy on sheets, and sometimes does not welcome slips. We use a rack or "gadget" which holds several hundred slips directly in front of the compositor. If the paper is not too flimsy, this works very well. Before going to the printer all slips, including cross references, should, of course, be consecutively numbered with a numbering stamp. After all, this mechanical work of recording and filing entries is only a very minor part of making a good index.

E. H. MCCLELLAND
CARNEGIE LIBRARY OF PITTSBURGH

SCIENTIFIC BOOKS

ASIATIC BOTANY

A Bibliography of Eastern Asiatic Botany. By ELMER D. MERRILL and EGBERT H. WALKER. Sponsored by the Smithsonian Institution, Arnold Arboretum of Harvard University, New York Botanical Garden and Harvard-Yenching Institute. Quarto. Pp. xlii + 719 (double column), 2 maps. Jamaica Plain, Mass.: Arnold Arboretum, 1938. Price, $12.50.

ALTHOUGH most large bibliographies defy "reviewing" in the ordinary sense, such an ambitious undertaking as that cited above should certainly be brought to the attention of all botanists and scientific libraries. It is the type of work whose every page betrays many hours of careful and persistent searching, note-taking and checking, not to mention the arduous task of proofreading and rechecking the numberless details for which none but the authors can be responsible.

Work on this bibliography of eastern Asiatic botany covered a period of ten years, beginning at the Smithsonian Institution in 1928 when Mr. Walker, engaged in identifying material at the United States National Herbarium, found it necessary to familiarize himself with the literature of the plants of China. The project grew in scope until the area finally covered by the bibliography comprises China, Japan, Formosa, Korea, Manchuria, Mongolia, Tibet and eastern and southern Siberia. In addition, the major published papers pertaining to adjacent areas, such as the Philippines, Indo-China, Siam, Burma, India and central and northern Asia, are included, "because of their importance in the study of the plants of eastern Asia, and because through them the subsidiary literature on these areas can be reached."

The bibliography proper (occupying 550 double-column pages and printed in a compact but very readable style of type) contains more than 21,000 titles listed by author. The majority of the entries are briefly annotated, and there are hundreds of cross-references.

Following the main section is an appendix consisting of (1) a list of older Oriental works, many of which have not been heretofore mentioned in botanical literature; (2) a reference list and index of Oriental serials, with titles given in English, in Chinese or Japanese characters and in transliteration; (3) reference lists of Oriental authors (also with the Chinese or Japanese characters); (4) a subject index (in three parts—general, regional and systematic); (5) a family index of generic names of vascular cryptogams and seed plants; and (6) an index of the principal geographic names used in the subject index. In addition, the bibliography is prefaced by a reference list of more than 1,200 serial publications that are cited, with their complete and abbreviated titles. These various indices and appendices render the work extremely usable, though the labor of their compilation must have been great. Fortunately, both Dr. Merrill and Mr. Walker have worked in the Orient and were familiar with many problems, such as the need for careful translation and uniform transliteration of Chinese, Japanese and Russian characters, that are uncommon to most bibliographic enterprises.

Bibliographies as thorough and as well appointed as this one are definite milestones in the progress of research, in no matter what field. With the bewildering increment of literature in all branches of science, the great need for bibliographies is scarcely to be disputed. The most serious problem these days is to find funds for bibliographic publication after the necessary work of compilation has been done. In the present case the assiduity of the compilers and the interest and generosity of the sponsors, including one anonymous contributor, are especially gratifying. Botanists and plant scientists of at least three continents are the beneficiaries.

PAUL H. OEHSER

U. S. NATIONAL MUSEUM

GRIGORE ANTIPA

Grigore Antipa. Hommage à son oeuvre. 10 décembre, 1867—10 décembre, 1937. Bucharest, Imprimeria Natzionalǎ, 1938. (Published under the auspices of the Roumanian Society of Sciences.) Pp. 727; numerous plates and illustrations.

THIS noble volume, admirably printed and illustrated, is a tribute to one of the wisest and kindliest of modern biologists—Director Antipa, of the Bucharest Natural History Museum, Haeckel's assistant for many years at Jena, ex-minister of agriculture and world-renowned leader in fresh-water fishery development. Tendered to him on his seventieth birthday by pupils and friends, it contains a bibliography of his writings, accounts of his work as scientist, sociologist, economist and museum director; but its main bulk consists of valuable scientific papers in French, German, Italian and English (very few in Roumanian). These touch almost every phase of scientific interest, from the weathering rate of sedimentary rocks in Switzerland and the Pliocene fauna of Roumania, to sardine fisheries on the Chilian coast and an article by our own Henry Baldwin Ward on "Environmental Stimuli and Salmon Migration"; we even have an article by Netzhammer on Christian martyrs in the Danube basin and one on the development of forensic medicine in Zurich. It is interesting to discover that American "pumpkinseeds" and "bullheads" have made their way into the Danube system; there are specially valuable articles on wheat rust, on vitamin D from Black Sea sharks' livers, on the science of museum display, where Antipa was a pathfinder; but perhaps the most important have to do with pisciculture, in which we recognized Antipa's leadership some years ago by inviting him to investigate and make recommendations for the Mississippi Valley fisheries. Space limits prevent listing of the 52 articles; suffice it to say that this volume should adorn every large biological reference library, and the separate articles should go into the bibliographies. And all of us who have enjoyed the hospitality of Dr. Antipa and his charming wife will rejoice in the worthy quality of this hearty tribute—headed by King Carol himself—to a gentleman and a scholar of the highest rank and a patriot who showed his mettle under the trying conditions of the German occupation of Roumania; and we may take courage for the future of scholarship in the proof it affords of his stimulating influence on the younger generation.

CHARLES UPSON CLARK

CITY COLLEGE, NEW YORK

REPORTS

PURE AND APPLIED SCIENCE RESEARCH AT MELLON INSTITUTE

EIGHTY-SIX industrial fellowships, of which 30 are multiple and 56 individual, have been in operation in Mellon Institute during its fiscal year, March 1, 1938, to March 1, 1939. These investigations have employed 161 fellows and 96 fellowship assistants. During this fiscal year the institute has spent $1,104,405 in carrying on these research programs and its broad studies in pure science, which have been becoming more and more important, according to the twenty-sixth Annual Report of the director, Dr. E. R. Weidlein, to the trustees of the institution.

Of outstanding interest in this report is the account of the investigations on the chemotherapy of pneumonia under way in the institute's department of research in pure chemistry. Several active compounds have been discovered, but none appears to be as generally suitable as hydroxyethylapocupreine. The conclusions of the medical collaborators, Drs. W. W. G. Maclachlan, J. M. Johnston, M. M. Bracken and G. E. Crum, following three years of clinical experience with this drug, demonstrate that the mortality figure in pneumococcic pneumonia in adults during the past year has been greatly reduced in those cases which received hydroxyethylapocupreine. In comparing the mortality figures of the chemically treated cases, which were of course smaller in number, with the serum-treated cases in Pittsburgh, for the same types of pneumonia during the same period of time, almost identical results were observed by these specialists. Hydroxyethylapocupreine, which has shown no evidence of disturbing vision, can be used effectively in all types of pneumonia. Clinical studies of the drug in cities other than Pittsburgh have been arranged for. Experiments have revealed that, in identical doses within the effective ranges, hydroxyethylapocupreine will protect against pneumococcal septicemia in mice better than sulfanilamide and fully as well as sulfapyridine. These comparative studies are being continued.

In the chemotherapeutic research the institute is supporting at the Western Pennsylvania Hospital in Pittsburgh, Dr. R. R. Mellon and a staff of eight have made extended comparisons of effective dosage and protective values, using large numbers of rats and mice and numerous aromatic sulfur compounds, with pneumococci and streptococci as infecting agents. Investigation of the mode of action of sulfanilamide indicates that the compound likely permits the overproduction of metabolic products by the infecting pneumococcus or streptococcus, which results in an alteration of the growth rate or growth character of the latter. Fundamental research in bacterial variation, using streptococci and tubercle bacilli, has supplied additional evidence that transformations do occur within the present accepted classifications. These findings are being applied both diagnostically and therapeutically as opportunity offers.

The pure research fellowship sustained in the institute by The Buhl Foundation, on the relation of nutrition to various phases of dental caries, has disclosed some new relationships of food to tooth decay and has improved certain necessary techniques. Investigation of the beneficent effects of fluorides in the formation of teeth resistant to caries has not been entirely conclusive. In an attempt to determine what factors in meat confer caries resistance to rat teeth, Dr. G. J. Cox and his coworkers on this fellowship have fed to rats a series of diets varying in protein content. No difference in caries susceptibility was noted from diets ranging by 5 per cent. steps from 10 to 55 per cent. protein. A similar study of varied calcium to phosphorus ratio showed that in the rat the mother during pregnancy and lactation can provide calcium and phosphorus for good teeth over a wide range of ratios of calcium to phosphorus. On the low ratios, however, mothers and young displayed detrimental effects of the diets so far as body weight was concerned. Some preliminary experiments have indicated that suppression of saliva leads to promotion of decay.

Under a Federal Government grant, the fellowship on air pollution control has been cooperating with the department of public health of the city of Pittsburgh in a thorough study of municipal air contamination. There are 100 stations for the collection of precipitated solids and 50 field men who make direct observations of smoking chimneys. There are about 5,000 stacks in the classes regulated by the city's anti-smoke ordinance; and there are 154,000 dwelling units, 119,000 of which burn coal for fuel, and none of them is subject to smoke regulation. Indications are that the dwelling units are the greatest source of air pollution in Pittsburgh during the winter months. At several points the air is being sampled for the purpose of measuring suspended solids. The study of autopsy material is being carried on at the Singer Memorial Laboratory in the effort to determine possible effects of air pollution as noted in Pittsburgh in causing or aggravating respiratory diseases. Answers to 100,000 questionnaires on the effects of smog have been tabulated and will be appraised by medical specialists.

Air Hygiene Foundation of America, a non-profit, science organization with headquarters and a multiple fellowship (Dr. H. B. Meller, senior incumbent) at Mellon Institute, represents a collective effort by 250 industrial employers in behalf of the health of approximately a million workmen. The foundation, in addition to its pure, basic research in industrial hygiene, furnishes company members with practical plant applications to prevent industrial illness and to foster industrial health. During the year the foundation's preventive engineering committee prepared and issued eight bulletins on measures for safeguarding occupational health. Under grants from the foundation scientific investigations progressed at Harvard University, the University of Pennsylvania, The Saranac Laboratory, and Mellon Institute. Two graduate fellowships were established at Harvard to train men in industrial hygiene under Professor Philip Drinker. Research in roentgenography at the University of Pennsylvania seeks to improve x-ray techniques for industrial purposes, as in large-scale medical examinations of groups of workmen. At The Saranac Laboratory Dr. L. U. Gardner, the director, has experimental data to support the thesis that various minerals associated with silica tend to inhibit its action upon the body. The foundation is collaborating in the work of various states and of federal agencies in the field and makes every reasonable effort to fulfill public needs for facts on industrial health subjects.

The report includes descriptions of accomplishments of many industrial fellowships during 1938–39. The multiple fellowship on anthracite showed how completely automatic heat can be readily obtained with Pennsylvania anthracite without the necessity of any attention for weeks at a time. The multiple fellowship on calgonizing found "Calgonite" advantageously useful in cleaning dairy equipment. The multiple fellowship on tire and industrial chains described a number of successful welding electrode coating compositions. Another multiple fellowship, the one on commodity standards, continued productively its studies of major problems in retail merchandising.

The multiple fellowship of the Cotton Research Foundation, an organization of philanthropic business men, expanded its personnel and work in trying to improve the cotton economy of the United States. New knowledge resulted from studies of hull bran, cottonseed proteins, nutritional properties of cottonseed meal, cotton line, and linters. Through the agency of the institute the foundation established research fellowships at the University of Texas, Texas Technological College, and the University of Tennessee, besides sustaining an investigation at the University of North Carolina and a fellowship on cellulose economics at the University of Pittsburgh.

The multiple fellowship on food varieties reached the full technological development of a line of special foods for the feeding of children beyond the strained foods age. The technical glassware fellowship developed methods and apparatus to evaluate "surface hardness" of glass. The heat insulation fellowship assisted in acquiring technical information on fireproof constructional materials and on all-asbestos insulating air ducts. "Kemite" and "Karcite," laboratory constructional materials, were further studied by another fellowship, with special attention to new raw materials, development of additional properties, and novel applications.

The industrial fellowship on meat merchandising, after three and a half years of research, attained the development to commercial status of a new process making an improvement in the palatability of beef through increase in tenderness and juiciness. The natural gas fellowship studied major problems pertaining to conditions of the distribution and utilization of this fuel. The multiple fellowship on organic synthesis entered its twenty-fifth year of continuous, creative activity. On the multiple fellowship on petroleum refining several new devices were evolved for quick and accurate measurements of physical constants of oil hydrocarbons. The pressing machinery fellowship announced a new, safer and purer type of petroleum naphtha and also improvements in filters and stills for purifying the liquids used in the dry-cleaning industry. The multiple fellowship on protective coatings progressed in investigations of the fundamental structure and properties of organic resin films on metals and other surfaces.

Twenty-two years of age, the multiple fellowship on refractories solved the riddle of "mottled" silica brick. The mineral products fellowship designed and supervised the erection of a large plant for manufacturing "Garspar," a new ceramic raw material, and developed two other silica products, "Garbond" and "Gartex." The multiple fellowship on steel applied the principles of carbon wire technology to the manufacture of stainless steel wire with beneficial results and devoted much study to problems of manufacturing seamless tubing. Some new uses for sulfur came from the researches of another fellowship.

Seventeen industrial fellowships began work during the year, and four other fellowships have been accepted and will soon start operation. Eight industrial fellowships concluded their investigations during 1938–39. Among the new fellowships the programs on acid recovery (prevention of stream pollution by waste pickle liquors), air filters, gypsum products, plastics in meter construction, criteria of excellence of pearls, and watch lubrication have already advanced by the acquirement of useful results.

During the calendar year 1938, 17 bulletins, 27 research reports and 43 other papers were published. Twenty-four United States patents and 30 foreign patents on fellowship inventions came to issue. The total publications for the 28 years ended December 31, 1938, have been 20 books, 174 bulletins, 803 research reports and 1,225 miscellaneous articles; 714 United States patents were granted during the same period.

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SPECIAL ARTICLES

DISINTEGRATION OF TOBACCO MOSAIC VIRUS IN UREA SOLUTIONS

CHANGES are known to occur in the structure of proteins when they are dissolved in concentrated solutions of urea. In the case of egg albumin, the alteration is quite marked,[1] whereas in the case of hemoglobin and of pepsin, the degree of the change is much less, for, although hemoglobin is split into half-molecules,[2] there appears to be no change in the special properties of these proteins. Recently it was reported[3] that solution of tobacco mosaic virus in 6 M urea and 0.1 M phosphate buffer caused a 100-fold increase in the diffusion constant of the material with no change in the virus activity. Since this would indicate a decrease in molecular weight from one of the order of several millions to one of about 100,000, and, since in many previous attempts[4] it had not proved possible to demonstrate the existence of low molecular weight material possessing virus activity, it seemed desirable to reinvestigate the effect of concentrated urea solution on tobacco mosaic virus.

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[1] F. G. Hopkins, *Nature*, 126: 328, 383, 1930; M. L. Anson and A. E. Mirsky, *Jour. Gen. Physiol.*, 13: 121, 1929; H. Wu and E. F. Yang, *Chinese Jour. Physiol.*, 5: 301, 1931.

[2] N. F. Burk and D. M. Greenberg, *Jour. Biol. Chem.*, 87: 197, 1930; J. Steinhardt, *Jour. Biol. Chem.*, 123: 543, 1938.

[3] V. L. Frampton and A. M. Saum, SCIENCE, 89: 84, 1939.

[4] W. M. Stanley, in *Handbuch der Virusforschung*, Springer, Wien, 1938.

A solution containing 10 milligrams of tobacco mosaic virus per cubic centimeter in 6 M urea and 0.1 M phosphate buffer at pH 7 was prepared at room temperature and determinations of virus activity, stream double refraction, turbidity and the amount of protein insoluble in 0.1 M phosphate buffer were made after different periods of time. Since it is not possible to measure virus activity in the presence of high concentrations of urea, the solutions used for activity determinations were diluted with 9 parts of distilled water, and portions of these with 9 or more parts of 0.1 M phosphate buffer at pH 7. These solutions were then compared with controls containing the same small amount of urea, 0.1 M phosphate buffer, and appropriate amounts of virus, by means of the half-leaf method using 30 or more *Nicotiana glutinosa* L. leaves in each test. The stream double refraction measurements were made directly on the urea-virus solution by the method previously described.[5] The turbidity measurements were made with a photoelectric colorimeter by comparing a constant depth of the virus-urea solution with a variable depth of a copper sulfate standard. It may be seen from Table I that solution in 6 M urea and 0.1 M phosphate buffer at pH 7 immediately caused a reduction in virus activity and that after 1, 8 and 96 hours only about 25, 1 and 0.1 per cent., respectively, of the original activity remained. It may be seen from Fig. 1 that this reduction in activity was accompanied by decreases in turbidity, in the amount of protein remaining soluble in dilute buffer, and in stream double refraction. Mehl[6] has also noted the decrease in stream double refraction in urea solutions.

TABLE I

Hours in urea	Virus in urea		Control		Estimate of per cent. reduction in activity
	Gm. protein/cc. in inoculum	No. of lesions/half-leaf	No. of lesions/half-leaf	Gm. protein/cc. in inoculum	
< 0.1	10^{-5}	42.7	38.3	5×10^{-6}	ca 50
	10^{-4}	103.9	46.2	10^{-5}	
1	10^{-4}	60.9	41.2	10^{-5}	ca 75
4	10^{-4}	37.5	10.5	10^{-6}	> 90
8	10^{-4}	12.4	7.8	10^{-6}	ca 99
30	10^{-4}	2.9	0.9	10^{-7}	> 99
96	10^{-4}	0.2	1.9	10^{-7}	> 99.9

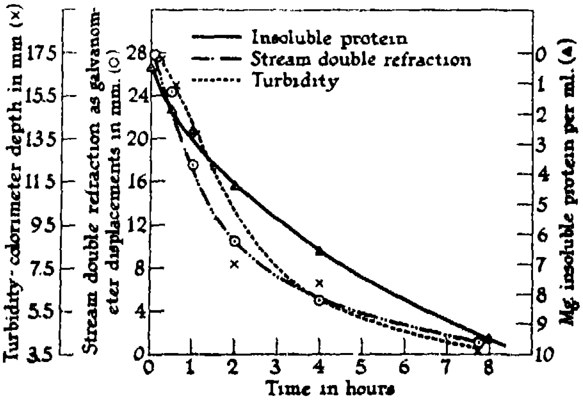

FIG. 1

The fact that the protein insoluble in dilute buffer was found to be free of nucleic acid indicates that the changes described above are due to the degradation of virus nucleoprotein. This disintegration was followed by means of osmotic pressure determinations which indicated an average molecular weight of about 100,000 after 5 days and about 40,000 after 4 weeks. The formation of low molecular weight material was also demonstrated by subjecting virus-urea solutions to high-speed centrifugation. In every one of over 50 experiments the low molecular weight, non-sedimentable material remaining in the supernatant liquids was inactive, and any residual infectivity was always associated with high molecular weight material which sedimented at a rate comparable to that with which ordinary virus sediments. The specific activity of remaining high molecular weight material, whether consisting of traces or of the major portion of the protein, was found to be from 10 to 50 per cent. that of ordinary virus protein. Following extensive disintegration, practically all the protein was found in the supernatant liquid and only traces in the sediment. Dilution of the supernatant liquids containing the low molecular weight protein with distilled water or with 0.1 M phosphate buffer or removal of the urea by dialysis failed to yield solutions possessing virus activity. Therefore, the disintegration does not appear to be readily reversible. The solution of virus in concentrated urea was accompanied by the appearance of a positive nitroprusside reaction, indicative of the formation of free sulfhydryl groups. These were estimated with the porphyrindin dye according to the method described by Greenstein.[7] The titration of a sample prepared by the addition of 2 grams of urea to 2 cubic centimeters of a solution containing 73 milligrams of virus at pH 8 corresponded to 0.70 per cent. cysteine. When 3.2 grams of guanidine hydrochloride were added to 2 cubic centimeters of the virus solution and the hydrogen ion concentration adjusted to pH 7, the titration after 1 hour corresponded to 0.76 per cent. cysteine. These results indicate that all or most of the sulfur[8] in tobacco mosaic virus occurs in the sulfhydryl groups which become free and measurable in concentrated solutions of urea or of guanidine.

The effect of 5 different concentrations each of sodium chloride, potassium phosphate and sodium citrate on the rate of disintegration of virus in 6 M urea at about pH 7.5 was determined by separating the high from the low molecular weight material by high-speed centrifugation after different periods of time. Disintegration proceeded most rapidly in 0.1 M phosphate buffer, slightly less rapidly in 0.05 M phosphate, 0.05 M borate and 0.02 and 0.04 M citrate, and less rapidly in 0.01 and 0.3 M phosphate and 0.004 and 0.12 M citrate. The rate was noticeably slower in 0.024, 0.12, 0.24 and 0.71 M sodium chloride and in 0.24 M citrate, and quite slow in 0.6 M phosphate, in 1.4 M sodium chloride and in the absence of electrolytes. The half-life periods of the native protein in the various urea-electrolyte solutions cover the range from less than 2 hours to more than a week. The effect of 4 different hydrogen ion concentrations on the rate of disintegration in 6 M urea and 0.1 M phosphate buffer was also studied. The rate was greatest at pH 8.2, slower at pH 7.4, much slower at pH 6.4 and almost negligible at pH 5.5. The disintegration of virus protein in 6 M urea and 0.1 M phosphate buffer at pH 7 is similar to the urea denaturation of egg albumin[9] in proceeding more rapidly at 0° than at 25° C., but differs from it by proceeding more rapidly at 40° than at 25° C. The rates of reaction during the degradation of about 90 per cent. of the high molecular weight material at 25° or 40° C. in 6 M urea and dilute buffers at about pH 7 may be described fairly satisfactorily by the equation of a first order reaction. However, the amount of high molecular weight active material remaining after about 50 hours, though quite small, may be as much as 10^6 times that predicted by the first order equation.

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[5] M. A. Lauffer and W. M. Stanley, *Jour. Biol. Chem.*, 123: 507, 1938; M. A. Lauffer, *Jour. Phys. Chem.*, 42: 935, 1938.

[6] J. W. Mehl, *Cold Spring Harbor Symposia*, 6: 226, 1938.

[7] J. P. Greenstein, *Jour. Biol. Chem.*, 125: 501, 1938. It is a pleasure to express appreciation to Dr. Greenstein for material and helpful suggestions.

[8] A. F. Ross and W. M. Stanley, *Jour. Am. Chem. Soc.*, 61: 535, 1939.

It may be concluded that tobacco mosaic virus is rapidly disintegrated in 6 M urea and 0.1 M phosphate buffer at pH 7, with appearance of free sulfhydryl groups, into low molecular weight protein components which contain no nucleic acid, exhibit no double refraction of flow, are insoluble in dilute buffers, and, most important, possess no virus activity. The rate of degradation varies widely with the concentration of urea, the concentration of electrolyte, the type of the electrolyte, the hydrogen ion concentration and the temperature. These results, especially the demonstration of the great effect of small changes in pH or in electrolyte concentration on the rate of disintegration, as well as the earlier work on the degradation of virus in solutions of sodium dodecyl sulfate,[10] may provide information concerning the nature of the forces which hold together the large virus molecule. The conclusion of Frampton and Saum[11] that virus activity is associated with the low molecular weight products obtained from tobacco mosaic virus upon solution in concentrated urea has not been confirmed.

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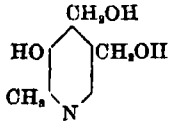
SYNTHETIC VITAMIN B_6

THE isolation of vitamin B_6 was reported by Keresztesy and Stevens,[1, 2] of this laboratory, and also by other workers.[3-6]

The structure of vitamin B_6 was studied at this laboratory, and the evidence which led to the structure is described fully in two papers[7, 8] which are about to appear. The structure of vitamin B_6 was shown to be 2-methyl-3-hydroxy-4,5-di-(hydroxymethyl)-pyridine,



I

I. Kuhn and coworkers[9-11] have announced the results of researches which led to the same structure for the vitamin.

In this laboratory, the complete synthesis of the vitamin B_6 has been accomplished, and we wish to describe the results of the comparison of the synthetic vitamin B_6 hydrochloride with the natural vitamin B_6 hydrochloride.[1]

M.p. 206–208° C., mixed melting point with natural vitamin B_6 hydrochloride, 207° C. Positive ferric chloride test.

Anal. Calc. for $C_8H_{12}O_3NCl$: C, 46.72; H, 5.84; N, 6.81. Found: C, 46.55, 46.64; H, 5.57, 5.69; N, 6.83, 6.75. The biological assay also confirms these findings.

A complete report of this work will be published in the near future.

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[9] F. G. Hopkins, *loc. cit.*

[10] M. Sreenivasaya and N. W. Pirie, *Biochem. Jour.*, 32: 1707, 1938.

[11] *Loc. cit.*

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[1] Keresztesy and Stevens, *Proc. Exp. Bio. Med.*, 38: 64, 1938.

[2] Keresztesy and Stevens, *Jour. Amer. Chem. Soc.*, 60: 1267, 1938.

[3] Lepkovsky, SCIENCE, 87: 169, 1938; *Jour. Biol. Chem.*, 124: 125, 1938.

[4] Kuhn and Wendt, *Ber.*, 71: 780, 1118, 1938.

[5] Ichiba and Michi, *Sc. Papers Inst. Phys. Chem. Research*, 34: 623, 1014, 1938.

[6] Gyorgy, *Jour. Amer. Chem. Soc.*, 60: 983, 1938.

[7] Stiller, Keresztesy and Stevens, *ibid.*, 61, May, 1939.

[8] Harris, Stiller and Folkers, *ibid.*, 61, May, 1939.

[9] Kuhn and Wendt, *Ber.*, 72: 305, 1939.

[10] Kuhn, Andersag, Westphal and Wendt, *ibid.*, 72: 309, 1939.

[11] Kuhn, Wendt and Westphal, *ibid.*, 72: 310, 1939.

XENIA IN THE CHESTNUT

The number of species of plants of horticultural importance in which xenia[1] is known to occur is surprisingly small. Since Focke in 1881 used the word xenia with reference to the immediate effect of pollen on the endosperm of *Zea mays* L., this plant has become the classical example of the process. Few references are found in the literature in regard to the type of xenia dealt with in chestnuts (*Castanea* spp.) namely, a measurable effect of the pollen on the embryo of the seed. Blaringhem[2] reported but gave no data on a case of xenia in the chestnut in which time of ripening and size of nut were affected by the kind of pollen used. However, his observations were based upon a small number of hybrid nuts. It should be stated that metaxenia, or the immediate effect of pollen on the maternal or sporophytic tissues of the plant, apparently is of much wider occurrence than xenia due to the complete absorption of the endosperm in most seeds.

In the chestnut the pistillate catkin produces from one to several "burrs," and each of these from one to five flowers, usually three, which if pollinated develop into nuts. Each nut develops from a single ovary. Normally one ovule develops in each ovary to form the seed of the nut, the kernel or fleshy edible portion of the seed being composed of the thickened cotyledons of the embryo. An extensive endosperm is formed soon after fertilization, but the growing embryo quickly absorbs this and "filling" of the nut consists largely of a thickening and increase in size of the cotyledons. Hence the nut of the chestnut is both a fruit and a seed, and the edible portion is the embryo.

The immediate effect of pollen on the seed of the chestnut is expressed through an increase or decrease in the size of the nut, depending upon the kind of pollen used. Since the nut is filled entirely with tissue of the embryo any differential size effect caused by different pollens on the same tree would be a result of the action of the pollen on extent of growth of the embryo. For the past two seasons a tree of the Japanese chestnut, *Castanea crenata* Sieb. and Zucc., has shown this differential effect, producing nuts of distinctly different size as a result of using two kinds of pollen. The tree normally produces large nuts typical of certain varieties of Japanese chestnut. On this tree when pollen from a variety of Chinese chestnut, *C. mollissima* Bl., bearing small nuts is used the mean weight of nuts produced is 18.77 grams. However, where pollen from a variety of Japanese chestnut bearing large nuts is used the mean weight of nuts is increased to 27.12 grams. A difference between the means of eight grams per nut has been observed both seasons, 1937 and 1938, as a result of the two kinds of pollen applied to the stigmas of this tree. With a variance of difference between the means of 1.828 grams this difference is highly significant. Analysis of data from this and other crosses will be presented elsewhere.

During the season of 1938 extensive crosses were made between varieties of three species of chestnut, *C. crenata*, *C. mollissima* and the European chestnut, *C. sativa* Mill. Many varieties upon which several pollens were used failed to show significant size differences between the nuts harvested. In all three species, however, certain varieties showed a variation in nut size that is clearly indicative of pollen effect on this character. The fact that this effect is not uniformly obtained in all the crosses between varieties or species suggests that nut size in the chestnut may be affected by genetic factors which are inherited from the pollen parent. Since the chestnut is considered to be largely cross-pollinated, the varieties within a species are probably heterozygous to a high degree. On this basis a genetic effect such as herein described could not be interpreted with certainty in all the varieties worked with due to a lack of knowledge of the genetic constitution of the trees. Increase in size of seed when two species are crossed is attributed by certain authors to heterosis or hybrid vigor. This interpretation could be given to instances in the chestnut in which the size of the nut produced by a tree is increased beyond that of either parent by using pollen from a tree bearing large nuts. Since the size of nuts produced by a tree bearing large nuts may be reduced by the use of the proper pollen, the writers consider that variation in nut size in certain chestnut crosses is due to the immediate effect of the pollen on the development of the embryo. It has long been a common observation that certain trees of the American chestnut, *C. dentata* Borkh., produced nuts with split shells, and this may possibly be explained by over-development of the kernel as a result of the action of the pollen of certain varieties.

The results of pollination experiments in the chestnut are at the present time entirely preliminary in nature. The practical implications of the problems involved, however, are many. One of the most significant of these is the fact that the quality of the kernel, as well as the size of nut, may possibly be affected by the variety of pollen used. If this is the case it should be possible to obtain greater uniformity of size and quality in chestnuts by planting the proper combination of varieties for pollination purposes. Chestnuts with split shells are attacked readily by molds and spoil quickly. Since the pollen of certain varieties determines the size of the nuts produced by other varieties, proper pollinators become important in the production of nuts free from split shells.

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[1] The generally accepted definition of the term "xenia" is used here, namely, "the immediate effect of pollen on the embryo or endosperm of the seed."

[2] M. L. Blaringhem, *Bull. Soc. Bot. de France*, 66: 354–356, November 14, 1919 (1920).

This type of experimentation provides a rapid method of carrying on certain phases of breeding work with this long-lived group of plants since the results of each year's work are available at the end of the current season. The kernel of other nut-producing species may also be affected by genetic constitution of the pollen, since wide variations in nut size and flavor are noticeable in several species.

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DIVISION OF FRUIT AND VEGETABLE
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SCIENTIFIC APPARATUS AND LABORATORY METHODS

CHLORAZOL FAST PINK BKS AS AN ANTI-COAGULANT

CLOTTING in systems recording blood pressure of animals is a frequent source of annoyance in kymograph experiments. The inexpensive methods of inhibiting clotting are, generally speaking, ineffective, while heparin, which is effective, is so expensive that its use is limited.

An effective and inexpensive anti-coagulant would be eminently desirable in any laboratory in which an appreciable amount of work is done which involves the direct recording of blood pressure. We were therefore interested in the properties of an anti-coagulant dye which was suggested by a former member of this department.[1] We have used it with such success, and we have been requested for information concerning its properties, use and preparation from so many sources that it was thought desirable to point out again that such a substance is available, and to record a simple method of purification of the crude product.

In 1932 Huggett and Silman[2] pointed out the anti-coagulant properties of Chlorazol Sky Blue FF (Chicago Blue). They found that the dye acted by inhibiting the clotting effect of calcium and thrombokinase on the fibrogen-prothrombase complex. The dye raised blood pressure slightly and had little or no effect on the gas-carrying power of the blood or the buffering action of the plasma. Later Huggett and Rowe[3] reported that many other azo dyes possessed anti-coagulant properties. Of a group which were examined Chlorazol Fast Pink BKS (Color Index 353) was found the most efficient; even more effective than heparin.

The crude dye was obtained from the General Dyestuff Corporation of New York City (trade name: Fastusol Pink BBA). Inasmuch as the crude dye is toxic it must be separated from salts and other impurities. A simple method of purification was sought. It was found that the dye was precipitated from an aqueous solution by alcohol, and a method of separation from impurities was based on this observation.

The crude dye is dissolved in about 15 parts of water and filtered. To the filtrate an equal volume of 95 per cent. alcohol is added, producing almost complete precipitation of the dye. The mixture is filtered and the precipitate saved. The filtrate should be colored only slightly by unprecipitated dye. The precipitate is washed with 70 per cent. alcohol, dried over steam and ground into a coarse powder.

This method of extraction yields about 20 per cent. of purified dye from the crude commercial product. A so-called commercially pure dye prepared by the General Dyestuff Corporation, which is too toxic as such, yields about 50 per cent. of purified dye by the same method. A dye supplied by the Calco Chemical Company (trade name: Calcomine Fast Pink 2BL) appears to be identical with Fastusol.

The purified dye is used in a 5 per cent. solution. It is relatively non-toxic. As much as 1.0 gm per kg produces only a slight increase in blood pressure, with some slowing of the heart and no effect on respiration. We have found that a single intravenous dose of 100 mg per kg (2.0 cc per kg of the solution) prevents clotting for many hours, and that specimens of blood from animals so treated do not clot in the test-tube for twelve hours or more. For most kymograph experiments 50 or 75 mg per kg suffice, but the 100 mg dose is more certain. These doses stain the animal and its urine, and cause bleeding and oozing from recently ruptured capillaries. It is best, therefore, to complete all operative procedures and to obtain complete hemostasis before the dye is injected. The dye should be injected immediately after cannulation.

A method of using the dye which does not involve intravenous injection has also been found satisfactory. Small amounts of the dye (0.5 cc portions) are introduced at about 30-minute intervals into the pressure system of the recording manometer just above the junction of the cannula and the rubber tubing. A fine needle (No. 25 or No. 26) is used. Some of the dye should go into the blood vessel connected with the cannula.

With the use of the dye other anti-coagulating agents in the pressure system are not necessary. We have discarded saturated sodium sulfate and magnesium sulfate and use only physiological saline in the pressure system.

Several hundred experiments of a variety of types have been conducted in this laboratory without any clotting or interference with the course of the experiment. Clotting has been prevented even in experiments in which agents which are known to produce intravascular clotting were used. The dye has proved very valuable in experiments conducted by students.

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[1] Dr. David Robert Climenko.

[2] A. StG. Huggett and H. Silman, *Jour. Physiol.*, 74: Proc. 9P, 1932.

[3] A. StG. Huggett and F. M. Rowe, *ibid.*, 78: Proc. 25P, 1933.

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EFFECTIVE CONTROL OF CULTURE MITES BY MECHANICAL EXCLUSION

INVESTIGATORS working with fungi *in vitro* are unhappily familiar with the common mycophagous mites, which invade their test-tubes and cause many inconveniences by destroying pure cultures or by contaminating them with other fungi or bacteria. Control of these pests is claimed to have been effected by the use of various volatile chemicals which purport to kill the mites and their eggs. Since plant and other materials harboring these mites are brought almost daily into most mycological laboratories reinfestations readily occur necessitating repeated use of these chemicals, most of which are detrimental to fungous growth and noxious to the person using them. The method of control which was developed and is now being used in this laboratory is based on the positive exclusion of the mites from test-tube cultures by mechanical means. The materials to be used are: (a) 10 per cent. gelatin in water to which has been added 2 per cent. $CuSO_4$ to prevent fungous and bacterial growth, (b) 1 book of L.L.F. cigarette papers and (c) a heavy blotter. About 25 cc of the melted gelatin is poured into a petri dish and allowed to solidify. The cigarette papers are taken from the cover, the small dab of glue that holds the sheets together is cut off, the bundle of sheets is cut in halves, placed in a small preparation dish and sterilized in the dry oven. This treatment with dry heat tends to make the papers separate more readily. The ordinary laboratory procedure now follows: The cotton plug is removed, the tube is seeded and flamed, but instead of replacing the plug the tube is inverted and the hot rim is pressed gently against the surface of the solidified gelatin, thus becoming coated with a thin film of melted gelatin. By touching the gelatin-coated rim to the cigarette papers in the preparation dish the top sheet is neatly picked up and removed and then made to adhere more firmly by pressing it against the resilient surface of the blotter. The tube is now placed upright in a rack with other tubes similarly prepared and so arranged that the corners of the projecting pieces of paper touch. By igniting at a single point, the projecting paper on all the tubes will burn off, leaving neat, circular, paper seals that effectively keep out all faunal and floral contaminants. When sub-cultures are to be made the seal is readily burned off by flaming, and after the transfer is completed the process of sealing is repeated as before. For cultures in liquid media the gelatin is melted and painted on the rim of the tube with a small brush and the paper then placed on top by means of forceps. If so desired, the cotton plug may be retained but should of course be shoved well below the rim of the tube before sealing. We have tested several brands of cigarette papers, many other kinds of paper, several grades of Cellophane and other materials. All Cellophanes and treated papers such as waxed papers greatly depressed growth of the fungi and of all the others tested only the one brand of cigarette papers made a perfect seal and burned without leaving an undesirable black residue. The efficacy of the method was tested by placing together in the same drawer sealed cultures, unsealed, cotton-stoppered cultures and unsealed cultures heavily infested with mites. After a period of months only the sealed cultures remained free of mites. This new method of mite control has the advantage over older methods of being effective, nontoxic to fungi, inexpensive and easily applied. An illustrated account of this and other mite-control methods will be published elsewhere.

The non-technical assistance by employees of the federal Works Progress Administration is acknowledged.

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THE OPPOSITION TO EUGENICS[1]

By Professor S. J. HOLMES

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THE sanguine eugenist looks upon the improvement of the inborn qualities of the race as an end so obviously worthy that he has difficulty in understanding how any intelligent and normally constituted person can fail to share his own enthusiasm for this cause. Even the man in the street must be aware that it is one of the greatest misfortunes to be ill-born, especially if this should cause one to be hopelessly deformed, blind, idiotic or insane, and that, on the other hand, it is one of the greatest blessings to be well born, to inherit a fine endowment of physical, intellectual and emotional characteristics.

Obviously, people differ in a large number of hereditary traits that profoundly affect their happiness and their value as members of society. It follows inevitably that the race would be much better off if we could eliminate the inherited factors that contribute to fill our asylums with morons and lunatics, and if the race were propagated by those of its members who are above the average in physical vigor, intelligence and emotional traits that make for sound character and a normal happy existence. Here is this race of ours carrying its burden of hereditary defects so numerous that a mere inventory of them would not be possible in the time allotted to this address. In this race of ours are also the genetic factors that afford the physical basis for the development of outstanding personalities whose achievements may be of incalculable service to their fellowmen. How, then, can any one fail to be in fundamental accord with the chief aims of practical eugenics, however great may be the differences of opinion as to how these aims may best be brought about? It seems, therefore, very simple and obvious to the enthusiastic eugenist that racial improvement is not only feasible, but that it should at once enlist the whole-hearted support of every well-informed and public-spirited person. If the eugenist is a simple-minded sort of individual, as eugenists are sometimes accused of being, and as in fact a good many of them are, he may be disposed to wonder why others do not find his mistress so fair as she seems to him.

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[1] Presidential address before the American Eugenics Society, New York, November 30, 1938.

Unfortunately, most people in this world, even educated and cultivated people, are little concerned about eugenics. There are many persons entirely wrapped up in their own affairs who naturally adopt the viewpoint of the man told about by Mark Twain who did not see that he should do anything for posterity because posterity never did anything for him. Some degree of unselfish interest in the welfare of future generations is required if any kind of eugenic doctrine secure approval. There are probably few, let us hope, who would be entirely indifferent to the welfare of posterity if their thoughts were once directed to the subject, although their interest might never be stimulated to give the matter more than a mild and perfunctory approval. Another reason for this indifference is that many people do not possess the knowledge of heredity required for a proper comprehension of eugenics, simple as the elements of this subject are. The only cure for this is, of course, education. But the task of the eugenist is not accomplished simply by the dissemination of knowledge of the elements of his subject, important as this is. The eugenist faces not only a formidable mass of ignorance and indifference, but also a considerable degree of positive hostility. We as eugenists must reckon with the fact that there are many people who do not like us at all. It is to this aspect of our subject that I would invite your attention this evening.

In seeking for the reasons for the opposition to eugenics it is important to bear in mind that the idea of improving the inborn qualities of man is, for the great mass of humanity, of relatively recent origin. To be sure, race improvement through selective breeding had been advocated by Theognis, Plato, Campanella and a few other lonely voices, but their doctrines were regarded more in the light of curiosities of philosophical speculation than as feasible measures for practical application. It was only after the doctrine of evolution came to be finally accepted in the scientific world that eugenics was brought clearly before the reading public as a subject to be seriously reckoned with. It was inevitable that the notion of hereditary variability and change through selection should be applied to man as well as to lower organisms, and that the possibility of further development of the human species should present itself to all who indulge in evolutionary speculation. The thought that man can determine the direction of his own evolution presented a novel and somewhat revolutionary view-point. Now the reception of any new point of view is profoundly influenced by the way in which it fits into the system of ideas already accepted. People are wedded to various brands of political, economic, social, moral and religious doctrine, and their reactions are antagonistic to any new ideas that threaten to unsettle their convictions in any of these fields. Often people scent a danger from afar and become prejudiced against ideas which are not so incongruous with their settled beliefs as they are prone to imagine. This, I believe, is particularly true with regard to the mental reaction of people to eugenics. Let us consider some of the sources of antagonism.

Eugenics is founded upon the doctrine of the natural inequality of man. The extent to which men differ by nature is a question upon which people are inclined to have different opinions on the basis of their political or social philosophy. Those of aristocratic leanings like to think that distinctions of rank and station go along with rather marked differences in hereditary endowment. Champions of equal rights, those who do battle against the powers of vested privilege, take comfort in the thought that the native qualities of the privileged classes are no better than their own, if as good.

There is a wide-spread prejudice in favor of egalitarianism, that tends to cause a reaction against any doctrine which threatens the security of convictions on this score. Nothing, of course, is more obvious than that human beings differ both in physique and mentality. But if these differences are environmentally caused through accident, disease, poor education or economic misfortune, they are, from the racial point of view, relatively superficial and largely remediable; whereas if they result from heredity they might, it is feared, be more difficult to overcome and would also afford a dangerous concession to the claims of aristocracy. If these inequalities can be attributed to the oppression of the prosperous and ruling classes, the moral appeal of the egalitarian gains thereby in strength. In his deservedly famous poem, Edwin Markham asks concerning the man with the hoe:

> Who made him dead to rapture and despair?
> Who loosened and let down this brutal jaw?
> Whose breath blew out the light within this brain?
> . . . Oh, masters, lords and rulers of all lands,
> Is this the handiwork you give to God?
> This monstrous thing distorted, and soul quenched?

The man with the hoe, as Markham pictures him, is a product of the iniquities of his fellowmen, the victim of oppression which has molded him into his repulsive shape. The wide-spread antagonism to the rich and successful classes creates a proneness to minimize their inherent endowments and gives a feeling of satisfaction in laying at their door the imperfections and failures of the downtrodden and oppressed. This attitude is heightened by a feeling of sympathy for the underdog, the championing of whose cause naturally appeals to our generous and chivalric impulses. The eugenists come in for a good deal of bitter invective because they are charged with teaching that poverty is, *ipso facto*, a proof of biological inferiority. In the class war the eugenists are often represented as arrayed against the exploited workers, whom they are accused by one writer at least of wanting to sterilize *in toto*.

Now, I am not condemning or criticizing these emotional attitudes, nor am I here concerned with how far class distinctions of any kind are founded upon a genetic basis. I am simply concerned with the reasons for a wide-spread emotional attitude toward eugenics. People do not like to believe that large numbers of their fellow creatures are to be branded as inferior physically or mentally as a result of their heredity. They much prefer to attribute the injustices of inequality to man than to nature.

Naturally, the attitudes of people on this subject are determined to a large extent by their political and economic views. This comes out clearly when we consider the prevailing opinion of socialists, communists and radicals of various brands. One finds all sorts of opinion on eugenics among the adherents of all these groups, but one can not fail to sense the prevalent emotional reactions I have mentioned in many adherents of these groups who deal with the human aspects of biology.

The influence of emotional bias in determining opinion comes out even more conspicuously when we consider the problem of the native endowments of different races. One needs only to point to the different attitudes on this subject prevailing in Russia and in Germany in order to show how profoundly views upon what is essentially a problem of genetics are determined by the dominant forces controlling public opinion in these countries. Rarely is the problem discussed anywhere without a tinge of bias one way or another, and these emotional attitudes carry over to a certain extent and influence the opinions of persons as to inequalities within the several races. Pride of race naturally arouses a resentment against the imputation of inferiority of the race to which one happens to belong. On the other hand, there is another emotional attitude that is noticeable in this connection, namely, a desire to take the generous and broad-minded view, to magnanimously concede to other races an equal or even superior endowment to one's own. Often, by way of good form, this is associated with a certain good-humored disparagement of one's own group. Unquestionably this attitude, which is sometimes merely a pose, is conducive to the maintenance of friendly race relations and helps to get rid of some uncomfortable problems. How far it has contributed to bring about the growing sentiment in favor of race egalitarianism it would be difficult to say. It has come to be the fashion to refer to race differences in mentality as if it were now demonstrated that no such differences exist, or, at least, that they are negligible in extent. In the light of our meager and unsatisfactory knowledge and the alternative possibilities of interpretation which existing data permit, this is, I think, a very unscientific position. Certainly a rigid demonstration that races differ in temperament and capacity for intellectual achievement is by no means so easy as it was formerly regarded. But the question is still an open one. Even relatively small average differences, and especially differences in the distribution of mental traits within a race, may be exceedingly important. Concerning the latter topic especially our information as to many racial stocks is very inadequate and we must patiently await further critically tested evidence before coming to final conclusions.

Opinions on the innate capacities of different races and peoples, like those on many other problems, are by no means free from the bias of financial interest. This has shown itself especially in relation to the regulation of immigration. The United States always faces the concrete and intensely practical problem of how to control the influx of aliens who would gain admission to our shores. The immigration of stocks affording a plentiful supply of cheap and tractable labor has been strongly supported by powerful financial interests. The argument that the admission of hordes of cheap laborers would work dysgenically in lowering the average level of our population is naturally countered by the declaration that the disabilities of these stocks are solely the result of their poor education and inferior economic status. Not wishing to incur the opprobrium attaching to the charge that they would sacrifice the future walfare of the country for the sake of securing gain, the promoters of free immigration are led to the egalitarian standpoint as a defense reaction. Considerations of monetary gains may, however, influence opinions as to the innate capacities of different stocks in diverse ways. They may lead to a defense of racial and class equality or to the justification of class distinctions. More frequently it is the latter for which the eugenist is berated as an ally of the capitalist in the endeavor to exploit and oppress mankind.

In this discussion I would emphasize the fact that I am not defending any doctrine concerning the extent to which either races or individuals differ in their endowment of genes. What I wish at present to call attention to are some of the emotional reactions and incentives that tend to shape opinions on these problems. Since very different views on these problems are commonly adopted in different regions and by members of different groups, one can not help thinking that the opinions of most people in regard to the natural equality of both individuals and races are determined, like their views on politics and religion, much less by the evidence of facts than by influences of their social environment, and especially by the political and economic theories to which they are wedded.

Another fertile source of opposition to eugenics is the fear that applied eugenics would involve a sacrifice of fundamental human rights which might lead eventually to an intolerable system. Mr. Darrow, for instance, declared: "In an age of meddling, presumption and gross denial of all individual feelings and emotions, the world is urged, not only to forcibly control all conduct, but to remake man himself! Amongst the schemes this [eugenics] is the most senseless and impudent that has ever been put forward by irresponsible fanatics to plague a long-suffering race."

Mr. Chesterton, for whom eugenics means marriage by the police, has worked himself up into a still greater fury than has Mr. Darrow. Eugenics in Chesterton's opinion is an intolerable menace to freedom, a thing to be destroyed root and branch, "a thing no more to be bargained about than poisoning." Mr. Chesterton is opposed to eugenics as he is opposed to prohibition and any and every meddlesome kind of interference with human rights. He is persuaded that the eugenist would ruthlessly invade the sanctity of the most intimate human relationships and direct the matings of human beings as he would breed live stock. Hence this doughty champion of personal liberty felt called upon to pour out his wrath in a fair-sized volume of mingled protest and vituperation.

A contributor to the *Living Age*, writing under the name of "Individualist," in commenting on the proceedings of the First International Eugenics Congress, expresses the fear that "I who write, and you who read, our brothers and our sisters, our children and our grandchildren, are all to be included in the proposed inquisition into the most sacred of our private affairs—an inquisition to be held apparently by self-appointed inquisitors obsessed by the dubious theories of an infant science. We might be chosen as fit, or dismissed as unfit, but we should thenceforward be labeled, classified, and without a rag of reticence left to us. Even were its knowledge of heredity absolute, the inquisition into the private lives of people involved in its proposals and the power it would place in the hands of the inquisitors would prove such a menace to personal liberty that I for one would gladly risk natural degeneration than be involved in an unnatural degradation so monstrous."

The solicitude for personal freedom expressed in the passages quoted is a sentiment which, in these days especially, is worthy of all approval. I have some difficulty in understanding how the last writer could become so thoroughly alarmed from reading the proceedings of the First International Eugenics Congress, but be this as it may, his apprehension became voiced in many other quarters. When the idea of improving human beings by selective breeding first began to impress the public mind people immediately began to have visions of a system of controlled matings as affording the natural if not the only way in which the hopes of the eugenists could be realized. Disparaging references to the methods of the stud farm and the breeding pen became very much in evidence. Unfortunately, some over-zealous enthusiasts gave a certain amount of color to this apprehension. Critics who like to represent the object of their attack in as unfavorable a light as possible raised the battle cry and took up arms in defense of human liberty, but the antagonism aroused proved to be all out of proportion to its justification.

The fear that eugenists might succeed in arbitrarily mating selected human beings without regard to their protests or their attachments elsewhere has, I hope, completely subsided. There remains, however, a good deal of opposition to placing any restriction upon the mating of any one sufficiently sane to be safely at large. We have long prevented the propagation of mentally defective and diseased persons on other than eugenic grounds without creating any outcry over the essential injustice of such a procedure, or without arousing a fear that the restrictions would come to include a much larger proportion of the population. It was only when it was proposed to restrict the propagation of the defective classes on eugenic grounds that the clamor arose. Unquestionably a considerable part of the opposition grew out of a reaction against interference with human rights. This conclusion will be borne out, I am sure, by a perusal of the copious literature that has accumulated on this subject. It is manifestly true in regard to sterilization, especially since this involves a surgical operation which deprives another individual of an important vital function. The imposition of this mutilation against the will of an individual for the sake of protecting posterity from his progeny is naturally apt to arouse an unfavorable emotional reaction that is overcome, if at all, only by a consideration of the more remote benefits to society resulting from this procedure. The menace to personal liberty arising from the sterilization of the unfit is particularly apt to impress the legal mind, and it is not surprising, therefore, that sterilization laws have encountered no small amount of opposition from the legal profession quite apart from any religious or egalitarian bias. Although thirty-one of our states have passed sterilization laws, it is largely because of the sentiments to which I have alluded that these laws have been so little enforced and in several states have remained practically a dead letter.

The opposition to eugenics on religious grounds springs from a number of considerations, although it can not be said that in general religion has proved to be inimical to the eugenic movement. Many persons believing that all human beings are of equal worth in the sight of God and that this world is merely a recruiting ground to furnish souls for the next, are apt to minimize the importance of human genetics in comparison with the concerns of eternal life. Even a low-grade imbecile, whatever his handicaps in this world, may be eternally blessed in his future existence; hence it would be wrong to prevent his coming into being through any arbitrary interference with the course of nature. Mr. Sommerville, in an article on "Eugenics and the Feeble-minded," published in the *Catholic World*, after condemning the segregation and sterilization of the feebleminded on the ground that their progeny might become a social burden, declares that "that kind of outrage on human rights in the name of social benefit is what Christianity has fought against since the days of pagan Rome." Christianity has always championed the cause of the meek and lowly and hence it can not approve of any measures that would prevent them from inheriting the earth.

Although the Catholic Church has never opposed the eugenics movement as such, and although many of its official representatives and adherents have espoused the cause of eugenic reform, the Church has set itself strongly against sterilization and birth control by artificial methods as contrary to nature and hence to the law of God. The regulation of reproduction on eugenic and hygienic grounds is conceded as entirely proper in the Pope's Encyclical Letter on Chaste Marriage; the end to be attained by curtailing reproduction is justifiable; but artificial means of attaining it are condemned as sinful. The few voices among prominent Catholics which had been raised in defense of sterilization on eugenic grounds have apparently now been silenced.

One source of opposition to the conclusions of the eugenists voiced formerly more frequently than now is a certain repugnance to the thought that human qualities are transmitted like those of the lower animals, and especially that mental traits and peculiarities are handed on through the physical mechanism of the germ-plasm. Not infrequently we find genius referred to as something almost supernatural in its nature—a sort of God-given trait that transcends the mundane things with which science has to deal. Galton shocked a number of his contemporaries by dealing with genius from the standpoint of the naturalist. To bring genius under the ordinary laws of heredity was almost a sacrilege. But the doctrine of mental heredity in any form was commonly held to have its dangers on account of its supposed materialistic implications. How can the soul, an immaterial entity temporarily associated with the body, be subject to laws of transmission determined by a physical mechanism? Theoretically, at least, any kind of a mind might be conjoined to any kind of a body. The prevailing outlook upon the mind-body problem, which was largely a development from primitive animistic concepts, naturally engendered a reluctance to carrying over to the mental realm the principles that applied to physical reality. The attempt to bring mind under the laws of heredity was to subject it to the laws of the material world and to deprive it of its freedom, its dignity, and even its prospects of eternal existence. The doctrine of mental heredity did not fit quite comfortably into the prevailing notions about mind and body, although there were various ways of harmonizing these view-points.

Although theological preconceptions have tended to influence opinions on the inheritance of mental traits, there are other forces that have apparently proven to be more potent. For a long time psychologists almost totally neglected the possible role of inheritance in the development of the mind. The experience philosophy, which would start the human infant with a *tabula rasa* at birth and explain the genesis of his faculties as a product of environmental contacts, had little use for heredity. Mr. J. S. Mill, who certainly can not be accused of any bias on theological grounds, declared that "of all vulgar modes of escaping from the consideration of the effects of social and moral influences on the human mind the most vulgar is that of attributing diversities of conduct and character to inherent natural differences." A similar standpoint has been expressed by Mr. Buckle, H. George and many other writers.

Adequate recognition of the role of heredity in psychology had to wait until the advent of the doctrine of organic evolution. Among the first to make much use of the concept of heredity in their psychological speculations were Lamarck and, more explicitly and logically, Herbert Spencer, the first edition of whose "Principles of Psychology" was published in 1855. Recognition of the important role of heredity in mental development has been growing for several decades. Many psychologists, on account of the influence which environment and experience obviously exert in the development of mental faculties, are still prone to minimize the role of genetic factors. Many educators and social reformers have apparently looked upon the inheritance of mental traits as affording a sort of challenge to the worth of their efforts. Being concerned with influences which affect the development of mind and character, they are rather dismayed by the thought that nature has set definite and very different limits to the developmental capacities of different individuals. The doctrine that mental differences depend upon heredity has been condemned as fatalistic, as an obstacle to progress and as tending to paralyze efforts at improvement. It would be much more encouraging to think of all human beings as capable of being molded to the limits of human capacity if the right influences were brought to bear upon them. In his volume on "Education and the Heredity Spectre," a book profoundly influenced by the Herbartian psychology, Mr. F. H. Hayward asserts that "Our physical qualities are inherited from our parents; our mental and moral qualities, however, owing to our impressionability and educability, are mostly superimposed upon heredity." This standpoint is still widely prevalent, but less so than formerly. Out of the abundant investigations in psychology, and especially educational psychology, during the last few decades have come many convincing evidences of the genetic determination of levels of intelligence, and nowadays many psychologists, students of education and social scientists emphasize the effect of genetic differences in mentality to an extent that would hardly be conceded by a conservative and critical eugenist.

Among the emotions and sentiments that determine people's reaction to eugenics there is, especially among intellectuals who have limited their families to below the maintenance level, a certain aversion to admitting that such limitation is in any way racially harmful. Such an admission would tend to be more or less unconsciously suppressed by what Freud calls the Censor, and a very natural defense reaction is to find reasons for holding that there is no real need for alarm over the differential birth rate. In talking with various people on eugenics and endeavoring to sense the influences that have shaped their opinions I have come to the conviction that back of their arguments there is a certain unconscious effort at self-justification. I admit that this is a more or less intuitive judgment, but it is quite in accordance with what we know of human nature. We tend to adopt those opinions that afford us the maximum of self-approval. People who have a goodly number of fine children are usually proud of their contribution and sympathetic toward eugenics. If they have few children or none they are rather more apt to conclude that there are perhaps too many people in the world anyway.

I am sure that I have not exhausted the sources of antagonism to eugenics that have their real basis in emotions and preconceived opinions. Much of the opposition to eugenics is primarily a sort of defense reaction arising out of a concern for ideas or sentiments to which eugenics is felt to be somehow antagonistic. The emotions aroused by eugenic theory or by proposed eugenic practices are varied. Writers who are alarmed over what the eugenists might do to us if they had their way commonly also attempt to minimize the influence of heredity in mental defect and disease, or even, in extreme cases, to deny such influence altogether. If one is prejudiced against legislative meddling in all personal affairs, he is apt to convince himself that adequate grounds do not exist whereby interference would be justified. If he is shocked by the mutilation involved in sterilization, he is apt to maintain that feeblemindedness and insanity are usually not hereditary, and that sterilization would accomplish practically nothing toward their elimination if they were. If one has certain mystical notions about genius and likes to think that it is something that defies all analysis and explanation by scientists, he may persuade himself by some carefully selected instances and by neglecting all statistical investigations of the subject that genius is as apt to come from any one kind of parents as from another, and that heredity has therefore nothing to do with its origin. But I am not attacking these rationalizations. All of them raise definite scientific problems. Highly trained geneticists may, and in fact do, come to different opinions as to a number of the theoretical as well as practical problems of eugenics. They also differ, but less widely, over several problems of genetics. Fortunately, when one is dealing with the genetics of fruit-flies or garden peas different view-points can usually be brought to an experimental test and definitely settled. The geneticist is happily free from any kind of bias resulting from religion, race prejudice or Marxian economics, although I am not entirely certain in regard to the last-mentioned topic. The poor eugenist has to struggle against many difficulties in establishing incontrovertible conclusions, and the geneticist may therefore look down a bit condescendingly upon many of the results of eugenic research. The opposition to eugenics which arises from the inadequate support which the eugenists have adduced for their conclusions is not to be deplored but much of the opposition is ill-founded or based on misunderstanding or ill-grounded fears, and some of it is simply silly. The eugenist faces the task of making his basic theses so well-supported and convincing that they will simply compel acceptance by all qualified judges. These theses should be so solidly founded that even the most captious individual can not find a way of squirming out of conceding their validity. As a rule you con not convince a prejudiced opponent if you leave him the least loophole through which he can escape coming over to your side. Most of the conclusions of the eugenist, however probable they may be, can not be demonstrated with the rigidity of mathematical proof, or with the definiteness of many facts of genetics. In this the eugenist is in the position of the student of statecraft or economics, and I might add, the practitioner of medicine. In these fields, in default of demonstrated truths for guidance, one must get along on the basis of the best judgments possible in the light of our present knowledge. Eugenic problems arise in which action one way or another has to be decided upon. As Galton pointed out, probability is the basis of eugenics, as in fact it is the basis of the much more exact science of genetics. I think that it may fairly be claimed that the scientific study of eugenic problems has yielded substantial support for several of the basic conclusions of the eugenist. As the difficulties attaching to such research are overcome, we may look forward to the time when eugenics becomes more worthy of the dignity of a true science, and when much of the alarmist and ill-founded opposition to it will have melted away like fog before the rays of the rising sun. It must be conceded that not a little of the criticism directed against eugenics is a very natural reaction to the ill-founded utterances of the eugenists themselves. The conception of eugenics burst upon the world suddenly. Some it inspired with enthusiasm to the point of intoxication and betrayed them, I am sorry to admit, into making many indefensible statements. Early in the history of the eugenics movement Galton stated that "the subject of eugenics is particularly attractive to cranks," and he expressed grave doubts as to whether the newly formed Eugenics Society was not doing more harm than good—doubts which I feel sure he would not have expressed could he have been acquainted with the present work of this organization. That object of Theodore Roosevelt's dread, the "fool reformer," has done eugenics a deal of harm. But writings on eugenics, I am convinced, are improving in quality. It should be the aim of the American Society of Eugenics to do everything in its power to place eugenics on a really scientific basis, to encourage research in this field and to disseminate only sound and sensible views on eugenic problems. The society should welcome members having wide differences of opinion. Sound progress in this field requires constant criticism, but while intelligent and constructive criticism is always wholesome, much of the opposition of the type I have discussed constitutes only an obstacle to progress. Misunderstanding, ill-grounded prejudice and antagonism based mainly on emotional complexes afford formidable impediments not only to carrying out practical eugenic reforms, but to the acquisition and dissemination of eugenic knowledge. These unfortunate impediments tend to deprive eugenics of the recognition and support required for its proper development. A great deal of the present opposition to eugenics has no real excuse for existing, but this opposition is a hard and obstinate fact which should be analyzed and understood if it is to be successfully overcome. I can not, of course, speak for all eugenists, nor all members of the American Eugenics Society, but I may express the hope that this society will make it known that, as eugenists, we are committed to no particular social, religious, political or economic creed, that we are no more concerned with the class war than the botanist or astronomer, that we are quite willing that Mary should marry Jack or any one else provided their progeny will probably not be imbeciles, lunatics or otherwise a burden to society; that we would like to have relatively more progeny from people with fine hereditary endowments, although we do not have the remotest intention of recommending any coercive measures for the attainment of this end; that we look to education and the development of eugenic ideals as affording the basic conditions for any noteworthy eugenic improvement; that we are desirous of encouraging the acquirement of sound knowledge of the biological factors of human evolution in the belief that the proper application of such knowledge will contribute fundamentally and fruitfully to promote the welfare of mankind. With these aims all intelligent and fair-minded people, I think, can not fail to be in accord.

OBITUARY

RAYMOND A. PEARSON[1]

1873–1939

Dr. Raymond A. Pearson, Scientist, Administrator, Educator, Planner, Builder, Statesman and Friend.

In a life span of less than the biblical threescore years and ten, Dr. Pearson earned the right to be designated as a leader in each of the six fields of agricultural activity set forth above. To few is it given to achieve that distinction.

Born in Indiana on April 9, 1873, he passed on at his home in Hyattsville, Md., on February 13, 1939, at the age of 66. In the meantime, he had served agriculture for seven years in the United States Department of Agriculture, ten years in New York State, fifteen years in Iowa, nine years in Maryland and, finally, again for three years and more in the Federal Department.

Scientist. While trained particularly in the science and art of dairying, Dr. Pearson spent most of his life in positions requiring administrative knowledge of many sciences and arts. It was his accomplished purpose to gain a personal knowledge of each of these sufficient to enable effective administration and presentation before legislative and administrative bodies.

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[1] Tribute presented to the National Capital Chapter, Iowa State College Alumni Association, Founders Day meeting, March 22, 1939.

Administrator. Of Dr. Pearson's forty-four years of active service, practically all were spent in administrative positions. Beginning in 1895, the year after his graduation from Cornell University, he was assistant chief of the Dairy Division of the Federal Bureau of Animal Industry, and all positions held thereafter were administrative. In his case there was not the usual probationary period in less conspicuous positions. From this service in the department, he became successively general manager of the Walker-Gordon Laboratory Company, professor of dairy industry at Cornell University College of Agriculture, commissioner of agriculture for the State of New York, president of Iowa State College, president of the University of Maryland and, finally, special assistant to the administrator of the Farm Security Administration. During this period he also had been president of the New York State Agricultural Society, 1908–1911; president of the Association of Land-Grant Colleges and Universities in 1923, and chairman of its executive committee from 1919 to 1935. In recognition of this long and faithful service, the association voted him a permanent honorary membership on the executive committee.

Educator. After seventeen years in administrative work, Dr. Pearson became president of Iowa State College in March of 1912 and remained in that capacity for more than fourteen years to the end of August, 1926. He then served as president of the University of Maryland for nine academic years, to 1935. In this period of nearly 24 years there was a most amazing development in the curriculums of agriculture, home economics, engineering and science. Of this development President Pearson was not only a part but a recognized leader.

Planner. Perhaps the better word is seer, because without vision there can be no planning. Dr. Pearson saw visions and dreamed dreams and then wrote them down as plans. This was not a one-man process but a matter of the meeting of many minds on the problems and procedures of institutional growth. So Iowa State College was developed, with a plan which has kept it what the founders started, a beautiful as well as a useful institution of learning, in a more than beautiful setting. So, too, was developed the University of Maryland.

Builder. It is one thing to plan and another to build the plan into accomplished fact. Dr. Pearson did both. No greater tribute can be given. Each institution under his administration has permanent mementoes of his ability in making dreams come true in brick and stone and beauty. He built, too, in finer, more priceless and more enduring materials than these. He built spacious and beautiful structures in the imaginations, the personalities and the characters of thousands of the young men and women of America.

Statesman. The characteristics already set forth constitute true statesmanship. The ability to see, to plan and to build are the measure of the administrator whose works shall last and, while they last, shall contribute to the building of the minds and characters of men and hence to the greatness and stability of the nation.

Friend. What has been said has concerned Dr. Pearson primarily as an official of various institutions. There remains yet the privilege of paying tribute to Dr. Pearson as a man and a friend. Many thousands of students, faculty and alumni will remember with pleasure and gratitude his personal interest in their problems, his rejoicing in their successes, his sympathy with their misfortunes and his firm belief in better things to come. His personal interest did not cease with his successive transfers to new fields of labor, but he kept a warm place in his heart for the scenes where he had labored and the people with whom he had been associated in the years before. This characteristic of Dr. Pearson, perhaps more than any other, will remain long in the memories of the Washington alumni of Iowa State College.

RECENT DEATHS AND MEMORIALS

DR. ALFRED STENGEL, vice-president in charge of medical affairs of the University of Pennsylvania, emeritus professor of medicine in the School of Medicine, died suddenly on April 10 at the age of seventy years.

ADOLF CARL NOÉ, associate professor of paleobotany at the University of Chicago, died on April 10 at the age of sixty-six years.

PHILIP E. BLISS, president of the Warner and Swasey Company, Cleveland, manufacturers of astronomical instruments and machine tools, died on April 11 at the age of fifty-three years.

DAVID JULIAN BLOCK, chemist, director of the Block Laboratories, Chicago, died on April 8. He was sixty-four years old.

HENRY A. WISE WOOD, chairman of the board and formerly president of the Wood Newspaper Machinery Corporation, inventor of modern high-speed newspaper presses, died suddenly on April 9 at the age of seventy-three years.

AT a memorial service held at the Cornell University Medical College for Dr. Charles R. Stockard, president of the board of the Rockefeller Institute for Medical Research and head of the department of anatomy of the college, who died on April 7 at the age of sixty years. The speakers included Dr. William Ladd, dean of the college; Dr. Herbert S. Gasser, director of the laboratories of the Rockefeller Institute, and Dr. James Ewing, director of Memorial Hospital, New York.

IT is stated in *Nature* that it is proposed to establish a trust fund to the memory of the late Professor Henry E. Armstrong. At the Finsbury Technical College and later at the Central College, South Kensington, Dr. Armstrong and his co-workers, Dr. Ayrton and Dr. Perry, tried out and established the principles of technical education in Great Britain, and thus encouraged the foundation of polytechnics and technical colleges. The hope is for a memorial fund amounting to about £3,000. This will provide a guarantee fund to give, as it accumulates, enough to ensure the publication (or to give substantial financial assistance in the publication or preparation) of any original works, within Professor Armstrong's recognized interests, that it would otherwise be impossible to publish. Publications will carry as frontispiece a portrait of Professor Armstrong, a biographical note and a reference to the foundation and objects of the trust. Furthermore, the fund will provide for a memorial plaque, or bust, for the City and Guilds College, South Kensington.

SCIENTIFIC EVENTS

THE NETHERLANDS GRAVITY EXPEDITION

HER Majesty's submarine 0-16 of the Netherlands Navy will leave Holland for the East Indies in May, on a new extensive gravity expedition sponsored by the Netherlands Geodetic Commission. The ship will be commanded by Lieutenant-Commander B. C. Meurs Schouten. The route of the expedition has been carefully planned in such a way that valuable scientific results may be expected. The submarine will proceed by way of Dakar, Capetown, and Durban to Java. The research will be carried out by Dr. W. Nieuwenkamp, attached to the Netherlands Geodetic Commission, which is to continue the gravity of the sea, so successfully pursued by Dr. F. A. Vening Meinesz on recent expeditions.

Observations will be made both with the multiple pendulum apparatus and with a new pendulum instrument of long period which was constructed for the measurements of the ship's accelerations and the determination of Browne's second order corrections. For timing the pendulum observations, the older chronometer will be replaced by the crystal chronometer constructed by the Bell Telephone Laboratories. This fundamental method for improving the timing of the pendulums was first used in 1937 on the U. S. Navy-American Geophysical Union Expedition under the direction of Dr. Maurice Ewing, who, together with Dr. Morison, perfected its application. The crystal chronometer was sent to the British Admiralty for their gravity cruise last summer by the International Commission on Continental and Oceanic Structure (Dr. R. M. Field, chairman), and is now on loan to the Dutch Navy under the same auspices. The increase in precision introduced through the use of the crystal chronometer has also been demonstrated on land by Ewing, Woolard and Johnson in investigations of the geological structure of the eastern coastal plain and reported by Dr. Ewing to the American Philosophical Society in 1937.

The Netherlands expedition will record its soundings by the echo method with the collaboration of naval authorities in effecting the special arrangements needed. It is anticipated that soundings will prove possible even when proceeding on the sea's surface and that a continuous series of soundings will give valuable data for the entire route of the submarine. It is expected that the results of this expedition will greatly assist in answering such questions as: (1) how generally deep ocean basins show positive anomalies as have been found in nearly all cases on previous trips; (2) whether gravity anomalies in the Atlantic west of Morocco show evidence of the continuation of the tectonic folding axis of the Moroccan mountain range; (3) whether the Mid-Atlantic Ridge and the Walfish Ridge in the South Atlantic are in isostatic equilibrium, and other geophysical questions arising concerning the areas crossed by the route. Observational material relative to gravity in the region of the Indian Ocean up to the present time is exceedingly scarce.

The expedition is indicative of important results that may be obtained through international cooperation, and it is hoped that a preliminary report will be included in the report of the Commission on Continental and Oceanic Structure at the Seventh Assembly of the International Union of Geodesy and Geophysics which is to convene in Washington next September.

THE SOIL CONSERVATION SERVICE

IN the annual report of H. H. Bennett, chief of the Soil Conservation Service, it is stated that during the past fiscal year farmers in 18 of the 25 states which had enabling legislation organized 72 soil conservation districts, with a total area of more than 38 million acres. By the end of June, 34 of these districts had entered into cooperative agreements with the Soil Conservation Service, and the farmers of 18 districts were already actively engaged in conservation work.

Farmers in conservation districts have provided virtually all supplies and materials required for erosion control measures, and the contribution of the Soil Conservation Service has been limited generally to technical service for planning and to types of labor and equipment not normally available on the farms within the districts. During the year, Soil Conservation Service demonstration work on privately owned land was continued and expanded. Operations were started on 18 new projects, and 59 demonstration projects were placed on a maintenance basis. At the close of the year, regular operations were being carried forward in 55 demonstration areas. In 111 other areas, erosion control measures were being maintained for continued demonstrations.

These projects, together with the erosion control work areas adjacent to Civilian Conservation Corps camps under technical direction of the Soil Conservation Service, comprised approximately 11½ million acres of privately owned land, and involved the cooperation of over 61,000 farmers and ranchers. Under terms of the cooperative agreements between the farmers and the service, more than 850,000 acres of land originally in cultivation will be converted eventually to uses less conducive to erosion. By the end of the year, 490,000 acres in the demonstration areas had been retired from cultivation and were being developed as permanent pasture, meadow or woodland.

Another development was the extensive spread of erosion control practices from service demonstration areas to outlying farms. Such soil-defence measures as strip cropping, contour tillage and winter cover cropping were adopted on a far wider scale than in any previous year. Land protection by terracing gained support in virtually every state. The service continued to direct an extensive erosion-control and land management program on four large western watershed projects where nearly 80 per cent. of the land is in public ownership. Efforts to reestablish the range cover in these areas were continued. During the year, conservation nurseries furnished 145 million trees and shrubs, mainly for use in demonstration areas; although some were supplied to Federal and state agencies cooperating in erosion control. Over two million pounds of field-crop and grass seed were furnished to cooperating farmers and agencies.

The service continued its program of basic research. By the close of the year, sixteen experiment stations were developing and testing principles and measures for combatting wind and water erosion. A new experimental watershed project was established near Hastings, Nebr., and work was continued at two similar projects near Coshocton, Ohio, and Waco, Texas. At these three watershed research projects, rainfall and stream flow over relatively large areas are being studied in relation to soil erosion and flood control.

EXPANSION OF FACILITIES AT THE WORCESTER POLYTECHNIC INSTITUTE

THE trustees of the Worcester Polytechnic Institute have recently authorized a $1,000,000 building program. However, expansion of the facilities at the college does not mean any increase in the restricted enrolment. The freshman class each year is limited to 180 students.

The first building to be erected will be a student activity center to cost $350,000, including a library and auditorium with a seating capacity of 975. Funds have been given the college as a memorial to a man prominent in the early development of the institute and his name will be given to the building at the time of its dedication. It will be erected on the west campus adjacent to Sanford Riley Hall, the freshman dormitory. Ground will be broken before commencement and the building should be completed by June, 1940.

The program also embraces an addition to Salisbury laboratories, now in construction, and remodeling of the old building, at a cost of $100,000; erection and equipment of a mechanical engineering building, $400,000; refitting the old mechanical engineering laboratories for the civil engineering department, $65,000; erection of a footbridge connecting the east and west campus, relocation of the tennis courts, development of a quadrangle on the west campus and remodeling of Boynton Hall for the use of the department of mathematics and construction of a faculty lounge, $85,000.

Plans for the mechanical engineering laboratory are being prepared and it is expected construction will be started within a year. Erection of this building has been made possible by bequests in the wills of Willard L. Ames, of New York, who was graduated in 1882, and Moses B. Kaven, of Worcester, who received his degree in 1885. Trustees and alumni propose to obtain additional funds for endowment and equipment. It is expected that the entire program will be completed by the opening of the fall semester in 1942.

LABORATORIES OF THE DELAMAR INSTITUTE OF PUBLIC HEALTH AT COLUMBIA UNIVERSITY

THE new laboratories and classrooms of the DeLamar Institute of Public Health of Columbia University will occupy the top three floors of the seven-story city health and teaching center nearing completion at the Presbyterian-Columbia Medical Center, 168th Street and Broadway. The building has been erected through an agreement by the Presbyterian Hospital, the trustees of Columbia University and the Department of Health of the City of New York. Its facilities will enable medical students at Columbia to receive practical training in public health similar to that which they receive in medicine. The laboratories and courses will also be open to physicians, dentists, nurses and graduate students. The plan has been worked out under the general direction of Dr.

John L. Rice, commissioner of health, and has the hearty endorsement of the university.

The first four floors of the building will be used by the city as headquarters for maternal care, child welfare, nursing and other public health services. The center will be one of the few to offer treatment to both tuberculosis and venereal disease patients.

The laboratories and research rooms above will be so equipped that they may be used for any field of research in public health. A model classroom, built to comply with the standard requirements of a public-school classroom in the city of New York, is situated in the southeast corner of the seventh floor. Besides being used for lectures, the room will provide opportunity for research into procedures necessary to protect the health of school children. The fifth floor will contain a laboratory designed specifically for research into diseases caused by industrial occupations and a statistical office where a complete record of the number, kinds and occurrences of various diseases may be kept. The general laboratory for students and research workers will be situated on the sixth floor.

The seventh floor will also house an air laboratory equipped for the study of the various sources of contamination of air in public places. A bacteriological laboratory, on the same floor, will contain all the modern equipment necessary for the study of bacteriology. The offices of Dr. Haven Emerson, executive officer of the institute, and his staff will be connected with individual laboratories completely furnished with chemical, physical and bacteriological facilities for private research. A water laboratory, a sterile room, a machine shop and three laboratories for general research complete the arrangements for the top floor.

There will also be a library, a student lounge and staff accommodations. The ground floor will contain an auditorium and exhibit hall where public health education will be carried on under the direction of the institute and of the Department of Health.

SYMPOSIA IN PHYSICS AT THE UNIVERSITY OF CHICAGO

Two symposia of interest to physicists are to be held at the University of Chicago from June 23 to 30, as follows:

I. *Symposium on Liquids and Polyatomic Molecules,* a joint symposium of the chemistry and physics departments, to be held on June 23 and 24 and on June 26 and 27.

The first part of the symposium is devoted to the liquid state (structure of liquids, viscosity, condensation of liquids, the fusion process, two-dimensional liquids, infrared absorption and hydrogen bonding). The second part includes discussion of visible and ultra-violet spectra of complex molecules, the color of dyes, refractivity, optical activity and liquid and molecular viewpoints in nuclear structure. The speakers include K. F. Herzfeld, B. E. Warren, J. G. Kirkwood, O. K. Rice, F. A. Ogg, Jr., J. E. Mayer, H. Eyring, W. D. Harkins, W. H. Rodebush, L. Pauling, R. S. Mulliken, E. Teller, J. Franck, T. R. Hogness.

II. *Symposium on Cosmic Rays,* June 27 to 30. The subjects to be discussed include:

The Intensity and Absorption of Cosmic Rays.
Geographic and Geomagnetic Effects.
Time Variations of Cosmic Rays.
Composition of Cosmic Rays.
Energy Distribution of Cosmic Rays.
Showers and Bursts.
Mesotrons and Other Heavy Particles.

The expected participants include:

P. Auger from Paris; W. Bothe and W. Heisenberg from Germany; P. M. S. Blackett and B. Rossi from England; J. Clay from Holland; G. Herzog from Switzerland; C. Anderson, V. F. Hess, T. H. Johnson, R. A. Millikan, W. F. G. Swann and M. S. Vallarta from elsewhere in the United States, and A. H. Compton, W. P. Jesse, M. Schein and V. Wilson from Chicago.

SCIENTIFIC NOTES AND NEWS

FIVE members of the Rockefeller Institute for Medical Research, all of them members of the National Academy of Sciences and two of them Nobel laureates, having reached or passed the age of sixty-five years, are retiring from active work. These are Dr. Alexis Carrel, who announced his retirement a year ago; Dr. Florence R. Sabin, who retired early this year; Dr. Karl Landsteiner; Dr. Phoebus A. Levene and Dr. Winthrop J. V. Osterhout. The mandatory retirement rule is being enforced in all organizations with which the Rockefeller foundations are connected. It is stated that pensions will be given and that every laboratory facility will be provided to enable those who retire to continue their research work on their own responsibility if they desire to do so.

PORTRAITS of ten past presidents of the Explorers Club, New York City, were unveiled on April 9. These were Rear Admiral Robert E. Peary, General A. W. Greely, Dr. Frederick A. Cook, General David L. Brainard, Carl E. Akeley, Vilhjalmur Stefansson (present president), George G. Heye, James B. Ford, Roy Chapman Andrews and Dr. Walter Granger.

A NEW Hall of Optical Science, part of the Division of Light, Vision and Optics, was opened on April 20 at the New York Museum of Science and Industry in

Rockefeller Center. The opening of the exhibition was marked by an anniversary luncheon in honor of William Bausch, vice-president of Bausch and Lomb Optical Company, whose experiments in optical glass manufacture, begun just twenty-five years ago, have resulted in notable achievements in this branch of American industry. Following the luncheon, the guests inspected the new exhibition, after which it was opened to the public.

THE doctorate of laws was conferred on April 14 on Dr. James Bryant Conant, president of Harvard University, at the Founders' Day ceremonies at Tulane University.

DR. ROBERT HEGNER, professor of protozoology at the Johns Hopkins University, has been elected a corresponding member of the Belgian Society of Tropical Medicine.

THE Order of Balboa was conferred on April 10 by the President of the Isthmus of Panama on Dr. William M. James, chief of the medical clinic at Panama Hospital, in recognition of his "work on tropical medicine, especially malaria and dysentery." Dr. James was formerly a member of the Health Department of the Canal Zone.

THE King of England has approved the award by the Royal Geographical Society of the Royal Medals as follows: The Founder's Medal to Arthur Mortimer Champion, for his surveys of the Turkana Province and the volcanoes south of Lake Rudolf; the Patron's Medal to Professor Hans Ahlmann, of Stockholm, for his exploration and glaciological studies in the Arctic. The Council awarded the Murchison Grant to Robert Bentham, for his mapping and geological investigations in Ellesmere Land; the Back Grant to Lieutenant Commander R. E. D. Ryder, R.N., for his captaincy of *The Penola* and his marine surveys on the British Graham Land Expedition; the Cuthbert Peek Grant to W. Vaughan Lewis, for his physiographical studies in Great Britain and Iceland; the Gill Memorial to J. V. Harrison, for many years' exploration in Central and South America and Southern Iran.

DR. PAUL W. BOUTWELL, professor of chemistry at Beloit College, was elected president of the Wisconsin Academy of Sciences, Arts and Letters at the recent annual meeting, held at the University of Wisconsin.

MR. ELLIOT, British Minister of Health, has been made president of the Public Health Congress to be held at Hastings by the Royal Institute of Public Health and Hygiene from May 23 to 27.

RICHARD WINGATE LLOYD has been elected a vice-president of the Franklin Institute, and Philip H. Ward, Jr., a member of the museum and of the memorial committee, has been elected a member of the board of managers. Mr. Lloyd has been a member of the board since 1934 and chairman of the museum and memorial committee since 1935.

PROFESSOR W. SPENCER HUTCHINSON, head of the department of mining engineering at the Massachusetts Institute of Technology, will retire at the close of the academic year. He has been a member of the faculty for seventeen years and has been head of the department since 1927, when he succeeded Dr. Waldemar Lindgren.

DR. S. W. FLETCHER has been appointed acting dean of the Pennsylvania State College and Experiment Station. He succeeds Dr. R. L. Watts, dean and director since 1912, who retired on January 1 with the title emeritus. Dr. Fletcher will continue to assist in the program of the Cooperative Wildlife Research Unit, which is sponsored jointly by the college, the Pennsylvania Game Commission and the U. S. Bureau of Biological Survey.

ARTHUR L. COOK has been appointed director of the School of Science and Technology of Pratt Institute, Brooklyn. He was head of the department of electrical engineering until last May, when he became acting director of the school.

DR. HUGH S. CUMMING, formerly Surgeon General of the United States, sailed on April 12 to attend medical conferences in Paris, Geneva and Scarborough, England. In Paris he will attend the meeting of the Permanent Health Office on April 23, in Geneva the Conference Health Committee of the League of Nations, beginning on May 4, and in England the International Medical Congress, which opens on July 1.

DR. WALTER T. SWINGLE, of the Bureau of Plant Industry, U. S. Department of Agriculture, sailed on April 8 for Rio de Janeiro. He went on the invitation of Dr. Oswaldo Aranha, Minister of Foreign Affairs of Brazil. Dr. Swingle will confer with Brazilian experts about the possibilities for the establishment of new agricultural industries, especially for export purposes. He will be gone for three months.

LLEWELYN WILLIAMS, curator of economic botany at the Field Museum, Chicago, who is now on leave in Venezuela to aid the government botanist, Dr. Henri Pittier, in the botanical exploration of that country, recently made a trip from Caracas across the Venezuelan Guiana, by way of Ciudad Bolivar and La Paragua. He was accompanied by Captain Felix Cardona, of the Venezuelan Frontier Commission. They journeyed in canoes up the Caroni River to regions very little explored botanically.

DR. W. M. MANN, director of the National Zoological Park, Washington, D. C., sailed on April 7 for South America with a consignment of animals that he plans to present to zoological parks in South American countries. He also will collect animals to bring back to the park in Washington.

DR. R. RUGGLES GATES, professor of botany in the University of London, King's College, took part in the celebrations in honor of Spallanzani at Pavia, held from April 10 to 14. He was a delegate from the Royal Institution and gave an address on "The Nature of Genic Differences."

THE title of the Pilgrim Trust Lecture to be delivered by Sir William Bragg at 8:30 P.M., on Monday, April 24, at the Washington meeting of the National Academy of Sciences is "History in the Archives of the Royal Society."

DR. W. F. G. SWANN, director of the Bartol Research Foundation at Swarthmore, gave a report of the work of the foundation at a meeting of the Franklin Institute in Philadelphia on April 19.

THE James Arthur Lecture on Time and its Mysteries at New York University will be given in the auditorium of Gould Memorial Library, University Heights, on April 26, at 8:30 P.M., by Dr. Arthur H. Compton, professor of physics at the University of Chicago. The subject of the lecture will be "Time and the Growth of Physics."

DR. CHARLES A. SHULL, professor of plant physiology at the University of Chicago, on March 30 addressed a joint meeting of the University of Kansas chapters of the Sigma Xi and the Phi Sigma and the Kansas Academy of Science. He spoke on "The Plant in Relation to the Water System of Its Environment."

PROFESSOR CARL C. SPEIDEL, of the School of Anatomy of the University of Virginia, gave an address entitled "Living Tissues in Action" before the New York University Chapter of Sigma Xi on April 4.

AT a colloquium in the department of zoology of Columbia University on April 11, Dr. Robert Cushman Murphy, of the American Museum of Natural History, presented an illustrated paper entitled "Insular Isolation Among Birds: a Discussion and Inquiry."

JEROME ALEXANDER addressed the Sindicato dos Quimicos do Rio de Janeiro on March 16 on "Colloid Chemistry and Some of Its Applications." A dinner followed at Pax Hotel, with about seventy-five chemists present.

A SERIES of popular science lectures sponsored by the Illinois State Museum for the season of 1938-39 was brought to a close on March 30 when Dr. J. Marvin Weller, of the Illinois State Geological Survey, spoke on recent experiences "Behind the Lines in China." The lectures were free to the public and were given monthly from October to April. The speakers, in addition to Dr. Weller, were: Dr. J Harlen Bretz, glaciologist, University of Chicago; Dr. W. M. Krogman, physical anthropologist, University of Chicago; Dr. John A. Wilson, director of the Oriental Institute; Dr. George D. Fuller, plant ecologist, University of Chicago; Dr. Henry B. Ward, zoologist, University of Illinois.

THE twentieth annual meeting of the American Geophysical Union and its seven sections (Geodesy, Seismology, Meteorology, Terrestrial Magnetism and Electricity, Oceanology, Volcanology and Hydrology) will be held in Washington, D. C., on April 26, 27 and 28. At the regular sessions of the sections, scientific papers will be presented. The principal feature of the general assembly, which will be held in the auditorium of the National Academy and Research Council Building on the afternoon of April 28, will be a symposium on geophysical prospecting. At this symposium papers will be presented as follows: geophysical methods in petroleum exploration, by J. Brian Eby; electrical and magnetic exploration in the mining industry, by Sherwin F. Kelly; and geophysical prospecting by the Federal Government, by F. W. Lee, J. H. Swartz and Irwin Roman. On the evening of April 27, a smoker will be held in Building D of the George Washington University, 2013 G Street, N.W.

THE *Experiment Station Record* states that the eighteenth International Congress of Agriculture will be held in Dresden from June 6 to 12, under the auspices of the International Confederation of Agriculture. It will be organized into sections of agrarian policy and farm management; agricultural instruction and propaganda; agricultural cooperative societies; cultivation of plants; viticulture, fruit growing and the cultivation of special plants; animal production; agricultural industries; rural life and the work of the countryman; and agricultural sciences (including the organization and encouragement of research in the field of agriculture).

THE Section on Education of the American Association for the Advancement of Science will hold a series of meetings and symposia and a dinner at the summer meetings of the American Association for the Advancement of Science, which are to be held in Milwaukee, Wis., from June 19 to 24. The meetings of Section I will take place on Tuesday and Wednesday, June 20 and 21. The program is in charge of Dr. Hulsey Cason, of the department of psychology of the University of Wisconsin, who is acting as secretary *pro tem.* All members and fellows of the association who wish to read papers at these meetings are urged to send abstracts of not more than 150 words to Dr.

Cason, so as to be received by him not later than May 20.

Wednesday, July 13, has been designated as Engineers' Day at the Golden Gate International Exposition by the San Francisco Engineering Council, which is sponsoring it as a red-letter day in the history of engineering achievement. The engineering profession is invited to attend this commemoration of the engineer's contribution to human welfare. This celebration will occur during the week of national conventions of the American Society of Mechanical Engineers and the American Institute of Mining and Metallurgical Engineers. It closely follows the national conventions of the American Institute of Electrical Engineers, the Institute of Radio Engineers and the American Association for the Advancement of Science. It closely precedes the national convention of the American Society of Civil Engineers and Western Chemical Congress. As all these meetings are to be held in San Francisco or vicinity, the time and place is particularly appropriate. The program calls for a morning assembly on Treasure Island with an address by an internationally known speaker, an afternoon inspection of the outstanding engineering and industrial exhibits at the exposition and an evening banquet.

The herbarium of the late Professor Glen P. Van Eseltine, botanist, of the N. Y. State Experiment Station at Geneva, has been given to Keuka College, New York, and is now installed. Professor Van Eseltine had made a special study of Carex for some twenty-five years and the herbarium contains a large number of critically named specimens both of his own collection and of others obtained by exchange. The other specimens represent a large number of species found around Washington, D. C., and in central New York.

DISCUSSION

A CLASSIFICATION OF WEEDS AND WEED-LIKE PLANTS

A series of discussions with various geneticists has led me to suggest a classification for weeds and weed-like plants. The word "weedy"—oftentimes used in quotation marks (Babcock and Stebbins,[1] 1938, p. 61) —does not always carry the same connotations to cytogeneticists as it does to taxonomists. The classification suggested below or some similar classification should remove the difficulty. While weeds and cultivated plants are included as two kinds of peregrinators, the initial division has been made on the spreading capacities of a species rather than on its association with man. The amount to which a species travels from place to place, whatever the cause, will determine the extent to which may be broken down the external barriers between previously isolated groups (species, races, populations, etc.). Plants which spread *with* man may be expected to exhibit the same cytological and taxonomic phenomena which are shown by those spread *by* him.

Peregrinators (weeds and weed-like plants):

A. Cultivated plants
  Plants intentionally grown by man
B. Weeds
  Plants unintentionally grown by man, in fields, gardens, pastures, lawns, etc.
C. Ruderals
  Plants spreading into man-created habitats (barnyards, roadways, dumps, etc.) though not actually cultivated.
D. Nomads
  Plants spreading widely and rapidly even when not associated with man. Here belong many potential weeds and here apparently was the source of many of our weeds. Species for the most part of river valleys, seashores and other habitats marked by bare and shifting soils. This group forms a series of transitions to

Non-Peregrine Species:
  The bulk of indigenous floras

It is a remarkable fact (with very natural explanations) that geneticists have worked largely with peregrinators and taxonomists largely with non-peregrine species. In order to obtain the necessary pedigree cultures geneticists have had very largely to limit themselves to the adaptable, easily germinated cultivated plants like maize, snapdragons and primroses; to weeds and ruderals like Datura; or to genera like Nicotiana and Crepis the bulk of whose species are among the peregrinators of one class or another.

The ability to spread beyond external barriers which has made the peregrinators good material for genetical experiments has at the same time made them taxonomically difficult. When a taxonomist says that a species is "weedy" he usually means not that it necessarily grows in cultivated fields, but that it has the taxonomic phenomena associated with most weeds. These phenomena, while they have scarcely been discussed in scientific literature, certainly exist. When I recently pressed an able taxonomist for a working definition of a weed, he immediately replied, "A species which is very common, very aggressive, very variable and which clutters up herbaria."

Correlated investigations in taxonomy and cytoexperiment to be reported here strongly supports this hypothesis.

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[1] E. B. Babcock and G. L. Stebbins, Jr., *Publ. Carnegie Inst. Wash.*, 504: 1–199, 1938.

METHOD OF PRODUCTION AND COURSE OF THE DIETARY DEFICIENCY STUDIED

Albino rats (Wistar strain) weighing 40 to 50 grams, from a stock kept on Purina dog chow were placed in individual cages with raised screen bottoms (½-inch mesh) and given *ad libitum* water and the following diet:

	Per cent.
Casein (flavin-free)[4]	18
Salt mixture[5]	4
Dextrose	32
Corn starch	31
Rice polishing concentrate[6]	6
Lard	5
Cod liver oil	4

Growth ceases after the third week on this diet. Sore and swollen eyelids and a definite keratitis appear after 6 to 8 weeks, followed by clouding and ulceration of the cornea.[7] Irregular loss of hair occurs on the face, shoulders and back. The skin of the extremities becomes dry, rough and often swollen and ulcerated. Animals survive on this diet for from 10 to 14 weeks, and show all the typical symptoms of riboflavin deficiency.

EXPERIMENTAL OBSERVATIONS

One rat showing advanced symptoms of the deficiency, one moderately advanced, and three showing early symptoms (after only 7 weeks on the above diet) were injected intraperitoneally with Mexican typhus virus. The inoculum used for the first two rats contained large numbers of rickettsiae, while that used for the last three rats contained relatively small numbers of organisms. For controls, 2 rats in an advanced stage of vitamin A deficiency were injected with large doses of rickettsiae, and three rats on a normal diet with relatively small doses.

The five riboflavin-deficient rats all died on the fourth, fifth and sixth days after injection. The peritoneal surfaces of all five of these rats were bathed with a mucinous exudate, sufficient in amount to allow the accumulation of about 0.5 cc from each by scraping lightly with a dull knife. Smears of the exudate from each case showed large clumps of serosal cells distended with rickettsiae in every low-power field. In many preparations practically every serosal cell was distended. This picture was found in female rats as well as in male rats. The distention of these cells was often so great that the nuclei were compressed into small hyperchromatic spherical masses. The exudate also contained many polymorphonuclear leucocytes, which were often heavily laden with rickettsiae, and many extracellular rickettsiae, probably escaped from ruptured serosal cells. In at least four of these rats, death was undoubtedly due to typhus infection, since uninjected rats in the same group survived them by several weeks.

One of the vitamin A deficient rats died on the sixth day after injection, at a time when death from the deficiency alone was anticipated. The peritoneal surfaces showed no grossly demonstrable exudate. Moderate numbers of extracellular rickettsiae were found in smears made by scraping the peritoneal surfaces of this rat. Very few rickettsia-laden cells were found, however, and no distended cells comparable to those which were seen in great numbers in the riboflavin-deficient rats. In view of the large original dose, it seemed possible that many of the organisms seen may have been survivors from those originally injected. The other vitamin A deficient rat was killed on the eighth day after injection. The peritoneal surfaces were normal and no rickettsiae were found in smears. One of the three rats on normal diet was chosen arbitrarily and killed for study on the fifth day after injection. Here again there was no peritoneal exudate. A few extracellular rickettsiae and a rare infected cell were found in smears from the peritoneum of this rat. The other two rats on a normal diet showed no external evidence of infection and were allowed to recover. It is well known that endemic typhus is never a fatal disease in normal rats.

Regaud-fixed Giemsa-stained sections of the tissues of three of the above riboflavin-deficient rats were studied. These sections furnished additional evidence of the markedly lowered resistance of these animals to the rickettsial infection. Not only were the majority of the serosal cells found to be laden with rickettsiae, but the endothelial cells in several organs were similarly invaded. In many areas, for example, every third or fourth Kupfer cell in the liver was greatly distended with these organisms. Rickettsiae have not previously been demonstrated in the Kupfer cells of experimental typhus animals under any conditions.

DISCUSSION

The above observations are believed to be of interest for several reasons. The technique described may well prove to be an important supplement to the methods now in use for the production of vaccines in rickettsial diseases. It is also possible that the method may be used advantageously in the study of filtrable viruses, especially those which have a relatively low virulence for experimental animals under normal conditions. Studies of this type of deficiency in experimental animals of other species are in progress.

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[4] Extracted twice over night with 60 per cent. alcohol and twice by refluxing for two hours with 95 per cent. alcohol.

[5] U. S. Pharmacopoeia XI.

[6] Borden Company, New York.

[7] O. A. Bessey and S. B. Wolbach, *Jour. Exp. Med.*, 69: 1, 1, 1939.

SUMMARY

Riboflavin deficiency, even in a relatively early stage, greatly lowers the resistance of the rat to endemic typhus, thereby resulting in a fatal disease. Not only the serosal cells, but also the endothelial cells in several organs, notably the Kupfer cells of the liver, become greatly distended with rickettsiae under these conditions. Preliminary experiments strongly suggest that advanced vitamin A deficiency, even when making animals markedly cachetic, does not have a comparable effect. Riboflavin deficient animals remain alive for several weeks with an abnormal intracellular metabolism. This type of deficiency is worthy of further study as a possible method of approach in the investigation of other intracellular parasites and filtrable viruses. Speculation regarding the mechanism concerned also suggests the desirability of a study of the effects of this deficiency upon the production of immune bodies in general.

HENRY PINKERTON
OTTO A. BESSEY

HARVARD MEDICAL SCHOOL

PRELIMINARY NOTE ON THE MODE OF UNION OF THE GALACTURONIC RESIDUES IN PECTIC ACID

CONSIDERABLE progress has been made in recent years in the field of the chemistry of pectic acid, particularly through the investigations of Link and his co-workers. However, the essential points in its structure are still missing, namely, the exact position of the linkage of the individual residues of the galacturonic acid, their ring structure and the length of the chain (if pectic acid has a straight chain structure). Levene and Kreider recently limited the place of union of the individual residues to positions (4) or (5). The choice between the two has not yet been made.

For the purpose of obtaining the missing information, pectic acid has been exhaustively methylated. The product thus obtained had a composition corresponding most satisfactorily to a structure composed of approximately six units.

$C_{56}H_{80}O_{37}$. Calculated. OCH_3, 45.80
Found. OCH_3, 45.40

On saponification the substance had the following methoxyl value:

$C_{50}H_{78}O_{37}$. Calculated. OCH_3, 34.18
Found. OCH_3, 34.80

Whether the material is only a methylated fragment of pectic acid can as yet not be stated. The deduction as to the length of the chain of this material is tentative, inasmuch as it is based only on the methoxyl value in the fully methylated and in the saponified material. More precise information on this point is expected from the analysis of the methylated polygalactoside, obtained on reduction of the above material. This substance has now been prepared by heating the exhaustively methylated material with copper chromite catalyst in an atmosphere of hydrogen at a temperature of 175° and a pressure of 3,500 pounds per square inch during 6 hours. The product has been obtained in only a fair degree of purity, having the following composition:

$C_{56}H_{102}O_{31}$. Calculated. C 52.9, H 8.1, OCH_3, 48.81
Found. C 53.8, H 8.0, OCH_3, 47.33

As far as can be judged from the rate of hydrolysis of the fully methylated pectic acid, the galacturonic residues seem to have a furanose structure, for after 2½ hours heating of the product with 0.01 *N* hydrochloric acid, at 100° C., about 1½ equivalents of reducing groups are developed and after 15 hours, about 3 equivalents. The methyl ester of 2,3,4-trimethyl α-methyl-d-galacturonide under identical conditions remained unchanged. (R. S. Tipson.)

Thus, it seems suggestive that the galacturonic acid residues of pectic acid have a furanose structure and hence the union of the individual residues is through carbon atom (5).

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VITAMIN E AND NUTRITIONAL MUSCULAR DYSTROPHY

IN 1931 Goettsch and Pappenheimer[1] described a dietary deficiency disease in rabbits and guinea pigs characterized by dystrophy of the voluntary muscles. Morgulis and Spencer,[2] Morgulis, Wilder and Eppstein,[3] found that at least two factors, both contained in whole wheat germ, were required for the prevention or cure of the disease. One factor was removed from wheat germ, previously extracted with petroleum ether, by 70 per cent. ethanol. The other factor was found in the unsaponifiable fraction of wheat germ oil. This suggested that the fat-soluble factor might be vitamin E. However, the dystrophy producing diet apparently contains a significant amount of vitamin E, since both Goettsch and Pappenheimer[1] and Morgulis[4] found that female rats grown and maintained on it exhibited "initial fertility" in the first and second generations. We have never observed "initial fertility" in even first generation female rats grown on purified E-deficient diets.

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[1] M. Goettsch and A. M. Pappenheimer, *Jour. Exp. Med.*, 54: 145, 1931.

[2] S. Morgulis and H. C. Spencer, *Jour. Nutrition*, 11: 573, 1936.

[3] S. Morgulis, V. M. Wilder and S. H. Eppstein, *Jour. Nutrition*, 16: 219, 1938.

[4] S. Morgulis, "Nutritional Muscular Dystrophy," Hermann and Cie., Paris, 1938.

In this connection our attention was directed to the fat-soluble factor by the observation that the paralysis of the hind legs exhibited by adult rats on a highly purified, E-deficient diet, could be prevented by administration of a highly potent vitamin E concentrate.[5] Our experience confirms Goettsch and Pappenheimer's observation that young rabbits, restricted to their diet 13, develop muscular dystrophy and die. We obtained the same results when 10 per cent. of ether-extracted wheat germ was included in the diet. Morgulis[4] noted increased excretion of creatine by rabbits with impending dystrophy. We have recorded the weight, food consumption and creatine excretion, day by day, while rabbits were maintained on diet 13, and have established detailed criteria based on these data, which enable us to predict with considerable certainty when the attack of acute dystrophy will occur. Remedial measures were instituted a few hours before complete collapse was to be expected.

With these criteria as a basis for diagnosis we were able to produce cures in rabbits on diet 13, plus 10 per cent. of ether-extracted wheat germ, by administration of small doses of our vitamin E concentrate.[6] Since the results strongly suggested vitamin E as the curative factor, we next fed natural alpha tocopherol.[7] There was a sharp drop in urinary creatine, accompanied by increased food consumption and gain in weight. Within a few days the animals were able to move about the cages without difficulty, and the creatine output had fallen to the normal level. We have, therefore, shown conclusively that one of the factors, deficiency of which is involved in causing experimental muscular dystrophy in the rabbit, is alpha tocopherol.

This study is being extended and the results will be published in detail elsewhere.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

"LUCITE" FOR MICROSCOPIC TRANS-ILLUMINATION

"Lucite," polymerized methyl metheerylate, is a transparent resin produced by the plastics department of the du Pont de Nemours Chemical Company.[1] It is optically similar to fused quartz in the following ways: it has a high light transmission in the visible spectrum,[2] a beam of light will pass around a bend in the material with very little loss of intensity, and there is a tendency for a beam of light to become concentrated at a constriction in the material. Because of these properties it is therefore well adapted to serve as a substitute for the quartz rod in microscopic transillumination, and has the added advantages of low cost of the material and the ease with which it is machined. Leiter,[3] Knisely[4] and McClung[5] have given the uses and methods of construction of the quartz rod for microscopic transillumination. This is presumably the first report of the use of lucite for this purpose and as a substitute for the Abbe condenser.

Construction of the Transilluminating Rod

Lucite is easily turned or shaped on either a machine or hand lathe.[2] A piece of one half inch round stock twelve inches in length was used. Four inches of this length were turned to a diameter of one eighth inch on a machine lathe at moderate speed with the application of water to make the cutting smoother. A thirty degree bevel was found to be most satisfactory between the one half and one eighth inch surfaces. Following the cutting operations, the surfaces were polished with jeweler's rouge while the lathe was turning at a high speed until a smooth surface showing no turning marks was obtained. The ends of the rod were polished in the same way. It is necessary to have both ends of the rod flat-surfaced, because distorted surfaces give a field of uneven illumination which makes critical definition impossible. After the rod was completely polished it was ready for the bending operations. The small end was softened in hot oil and bent to the desired angle, care being taken not to distort the small light-delivering surface (see illustration). The angle of the bend can be varied to meet the special require-

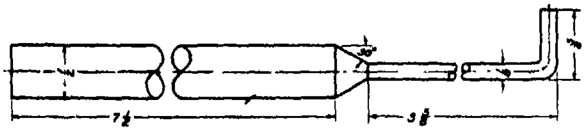

Fig. 1

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[5] C. G. Mackenzie, J. B. Mackenzie and E. V. McCollum. In press.

[1] The Lucite used in this work was graciously furnished by the E. I. du Pont de Nemours and Company, Plastics Department, 350 Fifth Avenue, New York City.

[2] Manufacturer's descriptive pamphlet on Lucite.

[3] S. B. Leiter, *Jour. Optical Soc. Amer.*, 11: 187–189, 1925.

[4] M. H. A. Knisely, *Anat. Rec.*, 64: 499–523, 1936.

[5] C. E. McClung, "Handbook of Microscopical Technique." Paul B. Hoeber, Inc. 2nd ed., 632–642, 1937.

[6] C. G. Mackenzie, J. B. Mackenzie and E. V. McCollum, *Pub. Health Reports*, 53: 1779, 1938.

[7] The alpha tocopherol was furnished by Merck and Co., Inc., Rahway, N. J.

ments of the work for which the rod is intended; however, an angle of ninety degrees was found satisfactory for most general work.

The Use of the Rod for Transillumination

The finished rod was supported by a burette clamp on a ring stand where it could then be adjusted to the desired position for operations. The light-delivering end of the rod should be placed in such a position that its surface is parallel to the surface of the microscope objective, this being necessary to produce a field of even illumination. The small tip can be inserted into incisions in live animals such as dogs, cats, rats and frogs for microscopic study of the living organs. For illumination of such tissues as frog or rat mesentery, a sixty-watt lamp placed at the large end of the rod gave sufficient light for observation. For illumination of structures containing pigment, such as liver, a light source of higher intensity will prove more satsifactory. When using the carbon arc for illumination over extended periods, it is necessary to place a water jacket around the large end of the rod to prevent the softening of the rod by the heat from the arc. Lucite rods have been found to give an even field of illumination at both high and low magnifications.

This illuminator may be also used as a very satisfactory substitute for the Abbe condenser and substage mirror of a microscope in general histological work. Sections thus illuminated stand out in brilliant definition. For all general histological sections, a "daylight" sixty-watt lamp gave ample light for oil immersion.

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LANTERN SLIDES FROM TYPEWRITTEN MATERIAL

A method of making lantern slides of tabular and text matter, which eliminates one step in the photographic process, is to type the data through white carbon paper on black paper. The ribbon indicator on the typewriter is set at the position for stencil cutting, to obtain as white an imprint as possible from the carbon paper. The material transferred as white on black paper is then photographed in ordinary daylight (artificial light does not give good results), Eastman contrast lantern slide plates being used as negatives. Each negative is bound with a cover glass as an ordinary lantern slide. This method results in slides that show black letters and figures on a white background and avoids the necessity of making positives after the negatives are made. Kymograph records on smoked paper can be mounted on black paper, the legends typed through the white carbon paper, and both the records and the legends will be reproduced photographically as black on white. Simple curves and diagrams can be traced through the white carbon paper onto the black paper. We have been unable to find a white typewriter ribbon on the market. For black paper we have found the "Black Antique Atlantic Cover" (20 × 26 – 65) of the Cook-Vivian Company satisfactory and for white carbon paper the "Panama White Carbon" of the Manifold Supplies Company, both of Boston.

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BOOKS RECEIVED

Actualités Scientifiques et Industrielles: 653, Leçons de Métrologie, III, Mesure des Temps, Vitesses, Débits. Pp. 110. 93 figures. 30 fr. *654, Physique Théorique, XXIII, Application de la Méthode du Champ Self-Consistent aux Noyaux Atomiques.* Pp. 88. 25 fr. *655, Photochimie, II, The Determination of the Mechanism of Photochemical Reactions.* Pp. 71. 18 fr. *656, Photochimie, III, The Photochemistry of the Halogens.* Pp. 53. 20 fr. *658, Bibliothèque de la Société Philomathique de Paris, III, L'Activité Électrique de L'Écorce Cérébrale.* Pp. 46. 14 plates. 8 figures. 15 fr. *662, Biochimie de la Choline et de Ses Dérivés, I, Choline-Neurine.* Pp. 61. 15 fr. Hermann, Paris.

Bates, L. F. *Modern Magnetism.* Pp. ix + 340. 97 figures. Cambridge University Press, Macmillan. $4.50.

Beghin, P. *Le Fonds National de la Recherche Scientifique et L'Industrie.* Pp. ix + 408. 135 figures. Le Fonds, Bruxelles, Belgium.

Canella, Mario F. *Orientamenti Della Moderna Biologia.* Pp. 141. Nicola Zanichelli, Bologna.

Dalcq, Albert M. *Form and Causality in Early Development.* Pp. 197. 64 figures. Cambridge University Press, Macmillan. $3.50.

Gustafson, A. F. and others. *Conservation in the United States.* Pp. xi + 445. 232 figures. Comstock Publishing Co. $3.00.

Heinrich, Carl. *The Cactus-Feeding Phycitinae: A Contribution Toward a Revision of the American Pyralidoid Moths of the Family Phycitidae; Vol. 86, No. 3053, Proceedings of the U. S. National Museum, 1939.* Pp. 331–413. 51 plates. Smithsonian Institution, Washington.

McCurdy, James H. and Leonard A. Larson. *The Physiology of Exercise; a Text-Book for Students of Physical Education.* Third edition, revised. Pp. 349. 2 figures. Lea and Febiger. $3.75.

Mitchell, H. L. *The Growth and Nutrition of White Pine (Pinus Strobus L.) Seedlings in Cultures with Varying Nitrogen, Phosphorus, Potassium and Calcium.* Black Rock Forest Bulletin No. 9, Henry H. Tryon, Director. Pp. vi + 135. 22 figures. The Director, Cornwall-on-the-Hudson, New York. $1.50.

Ricketts, Edward F. and Jack Calvin. *Between Pacific Tides; An Account of the Habits and Habitats of Some Five Hundred of the Common, Conspicuous Seashore Invertebrates of the Pacific Coast between Sitka, Alaska, and Northern Mexico.* Pp. xxii + 320. 112 figures. 46 plates. Stanford University Press. $6.00.

True, W. P. Editor. *Explorations and Field-Work of the Smithsonian Institution in 1938; Publication No. 3525.* Pp. 116. 122 figures. The Institution, Washington.

Vasconez, Pablo A. *Sintesis, Obras V.* Pp. 158. Editorial Labor, Quito, Ecuador.

Willis, L. G. *Bibliography of References to the Literature on the Minor Elements and their Relation to Plant and Animal Nutrition.* Third edition. Pp. 488. Chilean Nitrate Educational Bureau, New York.

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EDWARD ORTON, GEOLOGIST*

By Professor A. C. SWINNERTON
ANTIOCH COLLEGE

INTRODUCTION

SCIENTISTS whose names survive are associated mostly with innovations. Newton and gravitation, Darwin and evolution, Agassiz and glaciation, are inseparable. Recognition is seldom granted the humbler role of the interpreter. Now and again, however, there arises an interpreter whose knowledge is so broad, whose judgment is so sound, whose touch with common folk is so full of understanding and whose integrity is so far beyond reproach that recognition is given spontaneously.

Edward Orton was an interpreter. As one studies his life one finds that Orton's contributions to education, to the state and to science lay largely in the wisdom gained from the discoveries of others, in the perception of values and in the interpretation of them to his fellow men. His contributions in geology can be understood and appraised only by an examination of the man himself; hence this review of his career in science must include a survey of his early years.

I. EARLY YEARS

Edward Orton was born on March 9, 1829, when the presidency of the swashbuckling Andrew Jackson was but five days old. When he went to Hamilton College in 1845, conflict with Mexico was stirring emotions. All through his early years many conflicting views raged over political, economic and regional issues. The emotional tensions of people must have been similar in quality to those of our present day, the primary causes similar, though differing immensely in their applications. Candor in speech, honesty and objectivity in judgment, tolerance in human relations and ethical discrimination were not the characteristic of that day any more than they are of our times.

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* Part of an address delivered at the dedication of a monument and park—a memorial to Edward Orton—presented to the State of Ohio by Hugh Taylor Birch, of Yellow Springs, Ohio, October 26, 1938.

Orton was the son of a minister, and it seemed natural and desirable for him to shape his career toward the ministry. With this end in view, after being graduated from Hamilton College in 1848, he entered Lane Seminary in Cincinnati. However, he remained at Lane less than a year, and a period of preparatory school teaching followed, during which he instructed mostly in the natural sciences. He spent a part of a year in the early fifties in the graduate study of chemistry and botany at Lawrence Scientific School under Eben Horsford and Asa Gray. But he still felt the urge to enter the ministry, for he next turned to Andover Theological Seminary. Here with his friend, John Bascom, he broke with orthodox creeds. But apparently he hoped that his views were not too extreme to be reconciled with institutional religion because in 1855 he was ordained in the Presbyterian ministry as pastor of the church at Downsville, N. Y. However, he held that pastorate only one year; his ideas were too liberal for the church of that day. Soon the New York State Normal School at Albany called him to the chair of natural science.

But Orton did not forsake his religious affiliations. He undertook the leadership of a Sunday School class in one of the Albany churches. It was still a few years before the great controversy between science and religion aroused by Charles Darwin's "Origin of Species," but the seeds of conflict were already present. There is nothing to indicate that Orton deliberately attempted to be provocative; in fact, his nature, whatever his views, would lead him to a more conciliatory attitude. Nevertheless, his religious teaching was sufficiently unorthodox to develop an undercurrent of criticism. His position in the State Normal School should have been free from sectarian influence, but such was the temper of the times that trouble brewed and Orton resigned.

The record is not clear where the fault lay. It is difficult to tell how much pressure for Orton's removal was brought to bear on the school officials, how much he was upheld or to what extent he was made to feel the desirability of withdrawal. But he was sensitive to the situation and would not allow himself and his personal views to become a public issue. His friends began a campaign through the press to embarrass the management of the school and to bring about his reinstatement, but Orton settled the matter by a long public letter[1] in which he assumed responsibility for the situation and absolved the school administration.

Following the trying episode at Albany he became principal of the academy at Chester, N. Y., where he remained six years. Here he formed an intimate friendship with Austin Craig, who was pastor of an independent church at Blooming Grove, near Chester. We know little of the association of the two men; however, in 1865, Craig, who was then acting president of Antioch College, in Yellow Springs, Ohio, invited Orton to become principal of the preparatory department of that college. One may read much between the lines: the influence of Horace Mann at Antioch, the tradition of liberalism in thought and religion, the broader scope of the curriculum which included the natural sciences as well as the classical subjects, the new spirit in education expressed in coeducation and in a variety of other ways. All this must have made Antioch seem like "green pastures." At thirty-six, with much troubled experience behind him, he was just at the threshold of his career.

II. Green Pastures

The history of Edward Orton's eight years at Antioch is available only in outline form. From the college catalogues of those years we learn that he was principal of the preparatory department and, beginning in 1866, also Artemus Carter professor of geology, botany and zoology.

Professor S. C. Derby has given us a brief impression of Orton's relationship to the administration at Antioch:

> It is . . . years since my acquaintance with Dr. Orton began—at Antioch College where he was then the most influential . . . member of its faculty. As an inmate of the President's household, . . . I had unusual opportunity to know how much that officer trusted to the practical wisdom of the alert and untiring professor of Natural History, who was also the head of the Preparatory Department. . . . Then as always Dr. Orton toiled terribly; much of the discipline of an unusually heterogeneous body of students rested upon him; his instruction was not confined to his chair . . . but regularly included Latin, with History or English or a normal class in Higher Arithmetic. . . . His pupils there, as everywhere, were inspired with a good measure of his enthusiasm and carried forward by the forcefulness of his teaching.[2]

At the age of 43 Orton was invited to become president of Antioch. The position of the young college was not well established. Its financial condition was never strong, and its reputation for liberalism did not help fill the coffers. Orton deliberated, for he was not an avid career-seeker, but he accepted.

There is little record of his brief period of presidency, for the next step in his career came quickly. Two decades later he wrote to President Long, of Antioch:

> I look back upon the years which I spent there as among the most enthusiastic and fruitful of a lifetime spent in

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[1] *New York Tribune*, June 13, 1859.

[2] "In Memoriam Edward Orton," p. 55, Columbus, 1899.

> teaching. There was a certain zest and charm in the work there that I have never found elsewhere. I hope that my successors find equal interest and inspiration.[3]

During Orton's stay at Antioch the second geological survey of the state was authorized by the Ohio Legislature, and Professor J. S. Newberry, of Columbia University, was made state geologist. That Orton's scientific interests and abilities were known outside of Yellow Springs was indicated when he was appointed one of the two assistant geologists. He was assigned southwestern Ohio for his district; and in the first few volumes of the second survey there appeared from his pen more than a dozen county reports. The enthusiasm with which he was regarded by the survey staff is related by one of the young aids—Grove Karl Gilbert:

> I had no opportunity to meet Dr. Orton until late in the season, when I had the good fortune to be bidden to attend a conference of the chiefs at Columbus. While on the journey from Cleveland Newberry prepared me for the meeting by sketching the quality and character of his colleague—a man without guile, direct in his conversation, and absolutely transparent as to motive. The simplicity of manner which would impress me at the start was not of manner merely but was a fundamental trait coordinate with and not contradicted by the wisdom which made him a man of affairs. . . .
>
> In later years, as we met from time to time, as I listened to his voice in public address or read the papers that emanated from his pen, I was able to add here and there a detail which Newberry's sketch had failed to delineate, but no line of it was ever erased, and Orton has remained, for me, one of the safest and most open-minded of investigators and the simplest, kindliest, and most lovable of men.[4]

In 1872, after many years of discussion and controversy, the land grant college of Ohio was at the point of selecting its faculty and of opening its doors. A department of geology and mineralogy was to be included, and Orton was invited to become its professor. The Ohio State University catalogue of 1890–91 in its section on history contains this statement: "Professor Orton declined the professorship of Geology, but in April (1873) succeeding the presidency of the institution was offered to him, which he accepted in May."[5] It is clear that Orton did not give up his commitment of service to Antioch lightly.

Of the history of the Ohio Agricultural and Mechanical College others must speak who have more intimate acquaintance and knowledge than I. To an outsider who has only the published records to read, there appear to have been two major problems facing the new enterprise, both of which required tactful but effective leadership. One was external—the jealousy with which the other educational institutions of the state regarded the new college; and the second—internal dissension among the friends of the institution regarding education policy.

Ohio was one of the last states to organize its land-grant college. In the institutions organized earlier in other states various policies had been followed; some interpreted the Federal Act as intending only vocational education. Neighboring Ohio colleges were struggling with finance and striving to maintain educational standards; it was natural that they should regard with concern the establishment of a low-cost institution, which, if the views of some of its supporters were followed, would change and probably lower traditional standards. To a considerable extent the selection of Orton as president spread confidence. His inaugural address, in which he espoused ardently the cause of breadth of academic training as opposed to purely vocational instruction, left no doubt of the policy he would pursue. His practice followed his preaching. In 1875 there were nine departments offering work chiefly in science and languages. Orton asked the board of trustees for the addition of instruction in history, economics, government and ethics ". . . that the symmetry of the education which we offer may very soon be completed."[6]

In 1878 came the confirmation of the policy which Orton was following. The name of the Ohio Mechanical and Agricultural College became the Ohio State University. As if this made certain the policies for which he had worked, Orton proffered his resignation from the presidency. It was tabled. Subsequent insistence on being relieved finally brought the acceptance of his resignation in 1881.

We must remember that during this period of the presidency Orton was involved in both the work of the State Geological Survey and the teaching of geology. The Newberry survey had become quiescent, for the condition of state finances precluded appropriations for more large volumes, and little systematic field work was in progress. Professor Newberry made fewer trips from New York, and to Orton was left the editorial work and other duties of the state geologist.

Orton was also carrying the responsibility for the geology department alone; he appears to have had no formal assistance until 1895, when J. A. Bownocker was listed as assistant in geology. His daughter writes:

> My father was a very hard worker and took his class work seriously, at all times. We must remember that he had none of the labor-saving devices such as the typewriter, the dictating machine, etc., on which teachers nowadays have come to depend. The manual work of writing out his lectures in longhand—and he was very

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[3] "Letter to Daniel A. Long," January 11, 1895.

[4] "In Memoriam Edward Orton," pp. 21–22.

[5] Catalogue, Ohio State University, 1890–1891, p. 35, Columbus, 1891.

[6] Ohio Agricultural and Mechanical College, 4th Annual Report, p. 11, 1875.

careful to keep them . . . revised—plus his professional correspondence, kept him "burning the midnight oil" far too many nights.[7]

So effective was his teaching that his students and friends have perpetuated his memory in the building of Orton Hall on the university campus.

Such were the years of expanding responsibility and accomplishment. "Green Pastures" indeed, for Orton's abilities had found fertile soil and had made substantial growth. But his real career in geology was just beginning.

III. The Mature Geologist

When Edward Orton withdrew from the presidency of the university, he was 53 years of age. One can not help feeling that he was looking forward to the freedom from administrative responsibility. In addition to geology he had many private and community interests. He was a member of the First Congregational Church of Columbus and a close friend of the pastor, Washington Gladden, with whose religious view he was in close accord. He was concerned with municipal affairs and with many public institutions. Although these activities lie beyond the scope of this discussion, they emphasize his great breadth of human interest.

But in 1882 his chief geologic interests must have been his teaching and the continuation of the work of the State Geological Survey of which he was made director. Curiously enough, the geological work which was to constitute one of his major contributions to science was not yet apparent to any one.

In the work of the Geological Survey there were two major problems. The early survey which had been made of the coal measures, while satisfactory from the point of view of industry, was not adequate scientifically. It had been done independent of areas in adjacent states and was out of harmony; to use the geologic term, it could not be correlated. Orton undertook the re-study of the Carboniferous rocks and

> the outcome was that masterly presentation of the whole Carboniferous series of Ohio, in which the relations and variations of every prominent bed as it occurs within the state and adjacent portions of other states are presented in such fashion as to make the discussion distinctively one of the best . . . contributed to Appalachian geology. In this the awkward task of correcting the errors of those who had made the original observations is performed with a delicacy rarely equaled. . . .[8]

The second problem which apparently weighed on Orton's conscience was the promise made by the Geological Survey to publish information on the areal geology of the state, the stratigraphy, the paleontology, economic geology, and in addition agriculture, botany, zoology and even archeology. When Orton became director, only half of these items had been covered. Instead of reconstituting the survey and announcing new objectives when he was made director, Orton continued the second survey, and undertook to fulfil its promises.

It is noteworthy that from his interest in archeology and his inspirational contact with William C. Mills and E. O. Randall, there came the founding of the Ohio Historical and Archeological Society and eventually the Museum building on the Ohio State University campus.[9] Likewise, from his investigation of clays sprang the interest in ceramics which, through the efforts of his son, Edward, Jr., developed into a significant research and instructional department of the university.

An appraisal of Orton's work is particularly difficult to make, not because it was insignificant, but because he was an interpreter rather than an innovator. His work was done with little pomp and ceremony, and much was done by lecture, by letter and in personal interview. His published works were voluminous, but not in comparison with some of his contemporary geologists. In those days little restraint was exercised either in the length or number of published articles. His official reports frequently contain comment on commercial policies and practices, both public and private, of which he either approved or disapproved. One does not look for such "editorial" comment in scientific reports to-day, and yet it may well be asked if that frankness was not one of the most helpful of his public services in the protection of individuals as well as of public resources from wasteful losses.

The range of subjects covered in his writings is extensive. Aside from the county reports, and reports on coal and clay, already mentioned, he wrote extensively on oil and gas and on iron ores, building stones, salines, gypsum, lime, glacial gravels, hydrology and briefly on paleontology. In addition there are several papers of a general nature, such as "The Wastage of Our Coal Fields," and the presidential addresses before the Geological Society and the American Association for the Advancement of Science.

But the measure of the geologist is more than a summary of his publications. In order to understand his position in the world of geology let us review briefly the state of the science at the time Orton became state geologist. The great western explorations of the Powell, Hayden and King surveys had been made, and the results of these had been so significant in pointing the way to the development of the West that the organization of the United States Geological Survey was a natural consequence. Not only was there a great reaching out for the materials of an increasing industrialism aided by geological explorations; there was also stimulated a tremendous growth in geological ideas. Large fields of knowledge which we accept to-day as part of the structure of geology were only then becoming known. Physiography was just emerging, inspired by the Western surveys and later interpreted by William Morris Davis in terms of peneplains and rejuvenated and dissected surfaces. Vertebrate paleontology was describing the great collection of Mesozoic and Tertiary bones from the Western foothills and sedimentary basins. The structural complexities of Appalachian mountain-building had yet to be disclosed by the detailed field work of Hayes, Willis and Keith. The use of rock thin-sections still in its infancy was already producing results of great scientific values. The interior liquidity of the earth was largely unquestioned, for the seismograph in embryo had indicated nothing of its power to probe the depths of the earth, and radioactivity was unknown.

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[7] Personal letter from Mrs. F. C. Caldwell, September 19, 1938.

[8] J. J. Stevenson, *Jour. Geol.*, 8: 210–211, 1900.

[9] Personal letter from Dr. Samuel Orton, September 28, 1938.

This era of geologic discovery produced many great geologists and made many geologists great. We are interested in Edward Orton's place in that geological world of more than half a century ago. Obviously his place was not with those who were making scientific history by their discoveries in the mountains and in the Western plains. His position was assured by two great contributions: one which he planned as a necessary part of research, and one which came to him unexpectedly. The first was the detailed study and correlation of the Carboniferous strata of Ohio. This has already been mentioned in connection with Orton's work with the state survey. The significance of it need not be repeated; let me say only that it has served well as the foundation work for the geology of Eastern Ohio and adjacent regions.

The other enduring contribution related to oil and gas geology. It is a bit startling to be reminded, in these days of Gulf Coast and California gushers, that in 1886 Ohio had the largest oil and gas wells in the world. And all this development took place with startling rapidity. There was relatively little activity in these resources when Orton took over the state survey in 1882. By 1886 the Findlay field was the greatest producing field in the world; and so large was the relative production that the omnipotent Standard Oil Company was depressing the price, saying the market was glutted. Orton's official position gave him access to the drilling records and he was quick to learn the principles which underlie the occurrence of oil and gas. The anticlinal theory then recently propounded by White was found to fit the structural situation in Ohio, and Orton defended it stoutly. But that was not all. He studied the fragments the drill brought up and deduced the coincidence of the reservoir rocks with those parts of the Trenton limestone which had been changed to dolomite. He realized that these two factors, structure and rock character, together delimited the areas of production rather sharply.[10] He measured gas pressures conscientiously, contributing basically to our knowledge of "rock pressure."[11] He read voluminously, and in his writings he surveyed the whole field of both foreign and American literature critically. Reading his works over fifty years after they were written, one can not help being impressed with how little of significance has happened since—much change in detail, of course, but extremely little of basic principle. This impression is not just a vague sentimentalism. A text-book,[12] published late in 1937 in the field of hydraulics and carrying a chapter on oil field fluids, has a bibliography of 94 references for that chapter. Only 21 of those references were published prior to 1910; six of the works were written by Edward Orton and a seventh in collaboration with him! Only one other man in the whole list was referred to as many as four times. The test of time has certainly found his work of substantial quality.

During the height of his geologic activity, when he was returning to Columbus from a public lecture at Antioch, he was taken with a serious illness, which resulted in the paralysis of one side of his body. Despite this tremendous handicap he labored on with his teaching and research work unabated. Some of his most significant field work was accomplished following his illness. A letter which he wrote to a friend is characteristic of him:

> To any friends who inquire for me, I can describe myself in Scripture phrase as "faint yet pursuing"; overtaken by a severe physical disablement in the last public service that I undertook for the College, I have grown old, somewhat before my time. But "I bate not a jot of heart or hope." Life is still worth living, and the port well worth the cruise.[13]

His abilities were recognized by his contemporaries. In 1887, when it was planned to organize the American Geological Society, as an offshoot of the American Association for the Advancement of Science, Orton was made a member of the organizing committee.[14] This committee drafted a proposal for a constitution, which in 1888 was adopted with minor changes. This organization—the Geological Society of America—the leading society of its kind on this continent—celebrates this year its fiftieth anniversary. Edward Orton can be counted as one of its founders. Among the geologists famed for their remarkable discoveries in an age of great geological discovery, Orton was elected the ninth president of the Geological Society. No higher recognition was possible from geologists. But two years later, in 1899, the great body of American scientists—the American Association for the Advancement of Science—made him their president. During this year of office came his death.

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[10] *U. S. Geol. Survey Ann. Report*, 8: pt. 2, 475–662, 1889.

[11] *Am. Jour. Sci.*, 3rd ser., 39: 225–229, 1890.

[12] C. F. Tolman, "Groundwater," Chapter XIV, New York, 1937.

[13] Letter to Daniel A. Long, January 11, 1895.

[14] H. LeR. Fairchild, "The Geological Society of America," p. 72 *et seq.*, New York, 1932.

So we come to the close of the career of that quiet man who loved nature, who loved his fellow men and who served both well. That statement might be said to summarize his philosophy of life. He had as part of it a philosophy of his science. Some elements of this have already been referred to—for example, his willingness to comment forcibly on the methods of commercial exploitation of geological resources, and he was outspoken regarding the "self-deception" attending oil and gas booms. In this way Orton interpreted his relation to his public trust.

In matters of pure science he also had convictions. He stressed the essential unity of geology and protested the lack of breadth of understanding which was beginning to appear in specialization.

> . . . the methods of investigation and research employed in the several sections of geological science are so diverse that it is quite possible for those who work in one to fail in due appreciation of . . . all the rest.
>
> But the putting asunder of things which belong together is always to be deplored. It will be an evil day for geology when, by a confusion of tongues, the utterances of its various builders become unintelligible to one another.
>
> . . . Geology still demands of its students a wide range of knowledge and interest. Its most substantial progress will be due in the future as it has been in the past, not to the level and clinometer alone, not alone to the sagacious interpretations of the relics of life, not alone to microscopic section or to chemical analysis, but to all combined. . . .[15]

In fact, he felt the essential unity of all science:

> Every road in science leads to the end of the world. You can write the history of the vegetable kingdom from the beginning of time, in telling the story of the hyssop that grows on the wall.[16]

Ordinarily tolerant, he had no patience with pretense or with hypothesis founded on fancy rather than fact; for example, this forthright statement:

> These conclusions (he is discussing the vegetable origin of coal) are questioned by no one who has a right to an opinion. Occasionally it is true, some belated denizen of the seventeenth century still attacks the problem of the origin of coal in the *a priori* way and evolves a theory of its formation from his own consciousness. Such theories do not require refutation. Like the seed sown in stony places, they speedily wither because they have no root. Inventions and not discoveries, they are quite likely . . . to go to their own place and be buried with their inventors.
>
> The formation of coal from vegetable growth I do not take to be an unsolved or unfinished problem.[17]

His mind was open toward the future, and on this note I wish to conclude the discussion of Edward Orton. Science is unending, nor is it complete apart from its spiritual relation to man. The interpretation of this concept is unsurpassed in his statement:

> All these things we *know*. Must not such knowledge "grow from more to more?" Can we not be sure that the little problems . . . which now rise before us as unfinished will sooner or later find their solution?
>
> But when they are solved, will all be known? Nay, verily. Out of these old Carboniferous swamps, new questions, larger, deeper than any we now see, will perpetually arise, to stimulate by their discovery and to reward by their solution, that *love of knowledge for its own sake* which makes us men."[18]

OBITUARY

JACOB GOODALE LIPMAN

IN the passing of Jacob Goodale Lipman, who died at New Brunswick, New Jersey, on April 19, 1939, the agricultural world and particularly the field of soil science has sustained a loss that will be felt not only in the United States but throughout the entire world of scientific endeavor for the improvement of agriculture through the development of basic principles and practices. Dr. Lipman was born at Friedrichstadt, Russia, on November 18, 1874, but was reared on a farm in southern New Jersey. He received his early training at the Baron de Hirsch Agricultural School and his B.Sc. degree from Rutgers College in 1898. After serving as assistant chemist at the New Jersey Experiment Station for two years he took up graduate work at Cornell, where he received his Ph.D. in 1903. In recognition of his distinguished service to agriculture he was awarded the honorary degree of D.Sc. by Rutgers in 1923 and by the Catholic University of Santiago, Chile, in 1930. After serving his alma mater in various capacities he was appointed director of the New Jersey Agricultural Experiment Station in 1911 and dean of agriculture in 1915, both of which positions he continued to occupy until the time of his death.

As dean and director, Dr. Lipman has always been active in the affairs of the Association of Land-Grant

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[15] American Association for the Advancement of Science Proceedings, 34: 173, 1885 (1886).

[16] *Idem*, 180.

[17] *Idem*, 180–181.

[18] *Idem*, 197.

Colleges and Universities, and his advice and assistance have contributed greatly to the shaping of the policies and the guiding of the activities of this organization.

Beginning as a charter member in 1907 his interest and active support of the American Society of Agronomy has continued throughout the years.

In the midst of a busy administrative career Dr. Lipman not only continued his research activities but found time to serve as editor-in-chief of *Soil Science,* a journal which he founded in 1915 to serve as a medium for the publication of the results of basic soil investigations, and as associate editor of a number of scientific journals, both in this country and abroad. His publications include a long list of technical papers on soils, soil bacteriology and agronomy. In addition to membership in a long list of scientific societies, honorary technical fraternities and civic bodies, he was a corresponding member of the Swedish Royal Academy of Agriculture, French Academy of Agriculture, the Czecho-Slovakia Academy and other learned foreign societies. Dr. Lipman was a delegate to the International Institute of Agriculture at Rome in 1922, 1924 and again in 1926, and to the Third International Conference on Soil Science at Prague in 1922 and the Fourth Conference in Rome in 1924. His activities in connection with these international conferences on soil science resulted in his election to serve as president of the First International Congress of Soil Science, which was held in 1927 at Washington, and as chairman of the American delegation to the Third International Congress of Soil Science held in 1935 at Oxford, England.

In addition to those already mentioned, many honors came to him in the form of special assignments by the United States government to serve on special committees and his designation by state officials to serve on various boards and commissions concerned with public health and other matters of civic concern.

In recognition of his distinguished service in the interest of soil science, Dr. Lipman was designated in 1929 to serve as one of the representatives of the State Experiment Stations on a National Committee on Soil Erosion to formulate plans and make recommendations for a cooperative attack upon the soil erosion problem. Through the decade of development and transition from soil erosion to the broader concepts of a broad program of soil conservation he has contributed generously of his time and talent, always ready and willing to devote a day or two out of a busy week to conferences or field trips.

To his colleagues Dr. Lipman was a constant source of inspiration and friendly counsel and to his students a stimulus to the attainment of scholarship and the development of the research attitude of mind. So great was his enthusiasm for his work that the men under him or associated with him, even though they sometimes disagreed with him, caught the contagion and were inspired to higher achievements in their chosen field of soil science.

Those of us who were fortunate enough to obtain glimpses of his wholesome and well-balanced philosophy of life at various times and under different circumstances are fortunate. A young scientist who has not had the friendship of a man of Dr. Lipman's type is spared the grief that comes with his loss, but his life is lacking one of its greatest joys and the satisfaction that comes out of such associations.

A. G. MCCALL

U. S. DEPARTMENT OF AGRICULTURE

ADOLF CARL NOÉ

AFTER thirty-six years of varied services to the University of Chicago, Adolf Carl Noé died quietly in his sleep early on the morning of April 10, 1939. Dr. Noé, who had been in charge of the field of paleobotany for sixteen years, was to have retired on October 1, and he was particularly anxious to put his scientific "affairs in order." Saturday, March 11, therefore, found him at his office busy working on the final chapter of what will doubtless be his most important scientific memorial—the Stutzer-Noé Textbook on Coal. There, in the midst of his labors, he suffered the paralytic stroke from which he was unable to rally.

Dr. Noé was born in Gratz, Austria, on October 28, 1873, the son of Adolf Gustav and Marie (Krauss) von Noé. He attended the University of Gratz from 1894 to 1897, and the University of Göttingen from 1897 to 1899, during which year he came to the United States. Entering the University of Chicago he received the A.B. degree in 1900, and the Ph.D., in Germanic languages, in 1905. Although he was originally interested in the sciences, and had been a "demonstrator" in paleobotany at Gratz, he found it easier in this country to obtain employment teaching languages. After a year of such work at Burlington, Iowa, where, on July 3, 1901, he married Mary Evelyn Cullatin, Dr. Noé became instructor in German at Stanford University. Returning to Chicago he was instructor and assistant professor of German literature (as well as an assistant librarian) from 1903 to 1923. At this latter date he found it possible finally to return to his field of original interest, and he became assistant professor of paleobotany. He immediately outlined a course of study and offered work in the departments of geology and botany. The following year he was promoted to an associate professorship and made curator of fossil plants at Walker Museum.

Even before Dr. Noé succeeded in making a place for his subject in the curriculum at Chicago, he had in 1921 become geologist on the staff of the Illinois Geological Survey. This position he occupied until his death, his last active field season having been that of 1938. In addition, he had served in a similar capacity on the state surveys of Kentucky and Iowa. In 1927 he was geologist for the Allan and Garcia Coal Commission to Soviet Russia and did considerable pioneering work, especially in the Donetz coal basin.

In addition to the Stutzer-Noé Text now in press, Dr. Noé was the author of "The Fossil Flora of Northern Illinois," "The Golden Days of Soviet Russia" and "Ferns, Fossils and Fuels," as well as a number of shorter contributions. The now prominent study of "coal balls" was fathered in North America by Dr. Noé, and he and his students did much to bring it to its present position of importance. He was also an able technician, a student working under his direction having perfected the nitro-cellulose peel method for studying sections which now has such wide usage both here and abroad. Almost single-handed he assembled or obtained, through exchange, the paleobotanic specimens in the Walker Museum Collection. Thus he leaves a rich heritage of material collected on his numerous trips to coal mines in the central states, in Texas, in Mexico and in Russia. Probably more important, Dr. Noé for a number of years was essentially the only man in the New World offering complete training in paleobotany. Since, in addition, he had the ability to attract students of real promise, he leaves an active group of younger scientists who will be able to do what doubtless he himself might well have done had it not been for the quarter century Germanic literature hiatus in his scientific career.

In spite of the fact that his untimely death found him, like all good scientists, intensely dissatisfied with his own accomplishments, his worth was well appreciated in many quarters. He received the Sc.D. from Innsbruck in 1922 and, in 1923, the honorary Ph.D. from Gratz, as well as the gold medal of the University of Vienna. He was a member of the Société Géologique de France, the Geological Society of Mexico, and a fellow of the Geological Society of America as well as of the American Association for the Advancement of Science. He was vice-president of the Paleontological Society in 1931, and the same year held similar office in the Illinois Academy of Science. In 1927 he was chairman of the Chicago Section of the American Institute of Mining and Metallurgical Engineers, and in 1937 he was chairman of the Paleobotanical Section of the Botanical Society of America. In 1934 he became a research associate of the Field Museum and was responsible for the technical direction in the preparation of the museum's great reconstruction of a Carboniferous forest.

Dr. Noé engaged in many extra-curricular activities. He was an enthusiastic horseman, a redoubtable fencer and an expert marksman. For many years he coached the Chicago fencing team and was the instructor of the Rifle Club which he helped to organize. In 1921 Dr. Noé served as treasurer of the American Commission for Vienna Relief so successfully that the grateful nation bestowed upon him the Officers Cross of the Order of the Austrian Republic. Tall and distinguished, of noble birth, Dr. Noé was, in his joviality and innate kindness, kin to all mankind. He was as much at home with a simple coal miner as at the banquet tables of the great and near great. His fame as a raconteur was wide-spread, and his lectures, commonly illustrated with colored slides of his own manufacture, were in constant demand. That such a lovable character out of the "old school" will be keenly missed and kindly remembered, in many circles in addition to the scientific, is a poor understatement. His good friends were legion. They ranged from eight to eighty, from the impoverished to the affluent, from the uneducated to intellectuals.

Dr. Noé is survived by his wife and his daughters Valerie Noé and Mary Helen Noé Mulliken, wife of Professor Robert S. Mulliken, of the department of physics, University of Chicago.

CAREY CRONEIS

WALKER MUSEUM

RECENT DEATHS AND MEMORIALS

DR. CHARLES SUMNER HOWE, president emeritus of the Case School of Applied Science, Cleveland, died on April 18 at the age of eighty years.

DR. JACOB GOODALE LIPMAN, professor of agriculture at Rutgers University, dean of the College of Agriculture and director of the New Jersey State Agricultural Experiment Station, died on April 19 at the age of sixty-four years.

DR. THOMAS R. GARTH, since 1930 professor of experimental psychology at the University of Denver, died on April 20 at the age of sixty-seven years.

PROFESSOR HENRY BISSELL ALVORD, head of the department of civil engineering at Northeastern University, died on April 20. He was fifty-three years of age.

DR. CLARENCE FLOYD HIRSHFELD, chief of research of the Detroit Edison Company, died on April 19. He was fifty-eight years of age.

A PORTRAIT of the late Dr. William A. White, formerly superintendent of St. Elizabeths Hospital, Washington, has been presented to the hospital by the Rev. U. G. B. Pierce, president of the board of visitors, on behalf of Dr. White's friends and associates. Mrs. White has given to the hospital Dr. White's library relating to psychiatry and the general field of medical sciences.

SCIENTIFIC EVENTS

THE ROYAL RESEARCH SHIP "RESEARCH"

THE Royal Research Ship, *Research,* the non-magnetic vessel which has been built to the order of the British Admiralty, was launched on April 4. According to the London *Times,* the ceremony was performed by Mrs. H. Spencer Jones, wife of the Astronomer-Royal, in the presence of a large gathering. The religious service customary at the launching of a warship was conducted by the Rev. A. Shell, of Dartmouth. Lieutenant Commander D. H. Fryer, who will be captain of the *Research,* has received special leave from the Admiralty to make a voyage to Australia in one of the few remaining grain ships to gain experience of sailing ships in preparation for his new work.

In the meantime, the *Research* in brigantine rig will have made a voyage under sail to the United States to show herself to the Carnegie Institution, which was responsible for twenty years of similar work, and to begin her work where the American research ship *Carnegie* left off.

The heavy-oil engines, made by Petters, Limited, have been in course of construction for three years and are of bronze and aluminium—unfamiliar materials in Diesel engines—and much time has been taken and a great deal of money has been spent in obtaining satisfactory substitutes for the steel and iron which more generally go to the making of heavy-oil engines.

The task allotted to the *Research* demands that she shall be virtually non-magnetic. She has been built practically without iron or steel fittings. There are no steel cables. The cooking utensils are of aluminium. The baths are of teak. The ship's company of thirty-one persons will be required to submit their clothing and gear to inspection so that they may not take unwittingly on board any metal buttons or other possessions likely to affect the delicate magnetic instruments. With the engines likewise, it has been necessary to secure for them iron constitutions without using the ordinary magnetic iron and steel.

From 1909 to 1929 work was done on the *Carnegie,* which took readings and compiled records. That work still remains to be finished. The new wooden ship, with her non-magnetic engines, gear and, in the strictly physical sense, crew, will work in all the oceans, from the edge of the ice in the north to the edge of the ice in the south. She will endeavor to cross the tracks of the *Carnegie* where that ship recorded observations, and will make parallel records for comparison. The work may take a decade or more.

During the past three years the work of making four non-magnetic engines, three of which are for auxiliary duties, has proceeded. The fourth engine, which drives the propellers, develops 160 h.p.

The *Research* is a 770-ton sailing ship rigged as a brigantine with auxiliary engine. She will gather data on magnetic variation on behalf of the Admiralty, and the charts compiled will be made available to all nations in the interests of safe navigation for ships and aircraft. In the event of war the *Research* would carry letter of marque, signed by the Powers to protect her from attack. For her construction Booth and Company, of Birmingham, have supplied some of the heaviest non-ferrous sections produced by extrusion.

THE PUGET SOUND ENTOMOLOGICAL SOCIETY

ENTOMOLOGICAL workers in western Washington gathered at the University of Washington, Seattle, on March 10 and organized the Puget Sound Entomological Society. The objectives of the society are to promote the study of insects, arachnids and terrestrial arthropods in western Washington, and to promote the mutual welfare of the members through the exchange of ideas at meetings and field trips. Membership is open to persons of good character who are engaged in entomological activities. The society will hold two regular meetings annually, in February and October, the precise time and place to be determined by the executive committee, which is composed of three elective officers. The present officers are: Professor Trevor Kincaid, University of Washington, *president;* S. E. Crumb, entomologist, Bureau of Entomology and Plant Quarantine, *vice-president,* and Dr. E. P. Breakey, entomologist, Western Washington Experiment Station, *secretary-treasurer.* Special meetings may be called by the executive committee at such time and place as it may determine.

The organization of the Puget Sound Entomological Society was the result of a movement initiated in the autumn of 1938 by Dr. Breakey. Thirty-two persons with entomological interests, both professional and amateur, gathered in Puyallup on November 18, 1938. Many spent the afternoon visiting the Western Washington Experiment Station and the U. S. Bureau of Entomology and Plant Quarantine Field Stations in Puyallup and Sumner. In the evening the group gathered for dinner, after which a discussion was held on the desirability of forming a permanent organization. Dr. Breakey was elected provisional chairman and Charles F. Doucette, Bureau of Entomology and Plant Quarantine, Sumner, provisional secretary. The chairman appointed a committee on organization, Professor Melville H. Hatch, University of Washington, *chairman,* to present a constitution and by-laws for discussion and approval at the next meeting. A nominating committee, W. W. Baker, Bureau of Entomology and Plant Quarantine, *chairman,* was also appointed. The October meeting is to be held in Puyallup.

THE SEVENTIETH ANNIVERSARY OF THE AMERICAN MUSEUM OF NATURAL HISTORY

THE American Museum of Natural History celebrated on April 6 the seventieth anniversary of its founding. It was organized on April 6, 1869, under the leadership of Albert S. Bickmore, first president of the museum. From 1869 to 1877, the home of the museum was in the Arsenal in Central Park. The cornerstone in Manhattan Square, bounded by 77th Street, 81st Street, Central Park West and Columbus Avenue, was laid in 1874. To-day, with the addition of new buildings and wings, the value of the buildings is approximately $16,000,000.

The museum was erected almost entirely by the city, which also provides approximately a fifth of the funds annually required for maintenance, the balance being provided for by the endowment foundation, which is dependent mainly upon the contributions of trustees, members and friends.

President F. Trubee Davison, in discussing the early days of the museum, said:

> As life on earth has small beginnings, so had the American Museum of Natural History. During the first year of its existence, $44,500 were subscribed by citizens. By means of this sum the museum was able to purchase four collections consisting of 9,300 mounted birds, 200 fish and reptiles, 820 mounted animals, 4,000 mounted skeletons of mammals, birds, reptiles and fish and 250 specimens of Siberian fauna. The subsequent history of the museum has been one of almost continuous progress in its chief fields of exploration, research, preparation, exhibition, education and publication. To-day the floor space of the museum covers almost twenty-five acres, out of which more than half a million square feet are covered by exhibits in a total of some 60 exhibition halls and corridors.
>
> The number of specimens in the various exhibits and collections runs into many millions and covers virtually every field of the natural sciences illustrating life on land, in the sea, in the air and from the prehistoric past to the history-making present. The museum has done and is doing important work in research and publication, and in education from the primary school to the highest university grade. As a part of its educational program, it maintains a department of education which works in conjunction with the city's public schools and with other institutions, including those for the blind.
>
> For seventy years the American Museum has been building up a treasure-house of facts from all parts of the world, as well as from such intangible realms as psychology, human and animal behavior and the heavens above. These collections are adequately housed in our great museum buildings, but great as these collections are and generally unsurpassed as they are, much remains to be collected. Probably that task will remain uncompleted to the end of time, for knowledge has no limits, but every effort should be made day by day and year by year to fill in the gaps and further enrich the treasure-house. To accomplish this it is necessary for the museum to increase its operating funds and its endowment. Two years ago the museum adopted a ten-year development program which calls for an increase of $10,000,000 in endowments. The income from this fund would be spent in developing the museum's activities in all its branches.

THE AMERICAN PHILOSOPHICAL SOCIETY

AT the annual meeting of the American Philosophical Society, held at Philadelphia on April 20, 21 and 22, the following members were elected:

Class I—mathematical and physical sciences: Jesse Wakefield Beams, University, Va.; William Mansfield Clark, Baltimore; Arthur Byron Coble, Urbana; Enrico Fermi, New York; Charles August Kraus, Providence; Paul Willard Merrill, Pasadena; Stephen Timoshenko, Stanford University; John Hasbrouck Van Vleck, Cambridge, Mass. *Foreign:* Prince Louis Victor de Broglie, Paris; Godfrey Harold Hardy, Cambridge, England.

Class II—geological and biological sciences: Eliot Blackwelder, Stanford University; William Bosworth Castle, Boston; Wolfgang Köhler, Swarthmore; William de Berniere MacNider, Chapel Hill; Theophilus Shickel Painter, Austin; Peyton Rous, New York; Edmund Ware Sinnott, New York. *Foreign:* Sir Henry Hallett Dale, London, England; Johan Hjort, Oslo, Norway.

Class III—social sciences: Samuel S. Fels, Philadelphia; Guy Stanton Ford, Minneapolis; Felix Frankfurter, Washington; Philip C. Jessup, New York; Charles Seymour, New Haven; Harlan Fiske Stone, Washington; Charles Warren, Washington. *Foreign:* Eduard Beneš, formerly Prague; George Peabody Gooch, Cambridge, England.

Class IV—humanities: Van Wyck Brooks, Westport; Walter Johannes Damrosch, New York; Harry Miller Lydenberg, Scarsdale; Ralph Barton Perry, Cambridge; Theodore Leslie Shear, Princeton; Edgar Howard Sturtevant, New Haven; Lynn Thorndike, New York; Herbert Eustis Winlock, New York. *Foreign:* Martin P. Nilsson, Lund, Sweden; Sir Aurel Stein, Srinagar, Kashmir.

Officers reelected were: *President,* Dr. Roland S. Morris; *Vice-presidents,* Dr. Edwin G. Conklin, Dr. Robert A. Millikan and Dr. Cyrus Adler; *Secretaries,* John A. Miller and William E. Lingelbach; *Curator,* Albert P. Brubaker; *Treasurer,* Fidelity-Philadelphia Trust Company. New members elected to the council are *Class I,* Dr. W. F. G. Swann, director of the Bartol Research Foundation of the Franklin Institute, Philadelphia; *Class II,* Dr. Albert F. Blakeslee, director of the department of genetics, Carnegie Institution of Washington, at Cold Spring Harbor, L. I.; *Class III,* Dr. Harold G. Moulton, president of the Brookings Institution, Washington, and *Class IV,* Dr. Waldo G. Leland, secretary of the American Council of Learned Societies.

HARVEY CUSHING'S SEVENTIETH BIRTHDAY

Dr. Harvey Cushing's seventieth birthday on April 8, to which brief notice was given in these columns two weeks ago, is an event in American medicine of more than passing significance. Without fear of contradiction the *New England Journal of Medicine* at the time of his birthday referred to Dr. Cushing as the greatest figure that America has produced in medicine. His importance lies, not only in the fact that he has created a new field of surgery, but in his having established a school of surgery with ideals and traditions that have influenced the course of medicine in every civilized country. No other American physician in the annals of our history—not even Welch—has attracted so large a group of foreign pupils, and the altogether spontaneous outpouring which came on April 8 from his pupils and admirers in every corner of the world bears outspoken testimony to his enormous influence.

It devolved upon the Harvey Cushing Society, which elected to hold its eighth annual meeting in New Haven (April 6 to 8), to arrange the birthday party. In view of Dr. Cushing's well-known abhorrence of pomp and circumstance, the society insisted upon having a small family party restricted to its membership, one invited guest for each member, and several guest speakers. The society's usual program of papers was read on Thursday and Friday, April 6 and 7; on Friday evening, Dr. J. F. Fulton gave an account of his trip by clipper to the southern Philippines in search of *Tarsius* monkeys, and on Saturday morning operations, clinics and experimental demonstrations were presented before the society. The birthday banquet took place on Saturday evening. Dr. Louise Eisenhardt, president of the society for 1939, was in the chair and opened the exercises by reading an amusing letter just received from President Roosevelt. The other speakers included: Dean Stanhope Bayne-Jones, of the Yale School of Medicine; Dr. W. W. Francis, protobibliothecary of the Osler Library and nephew of the late Sir William Osler; A. M. Muirhead, bibliographer and author of the life of Lady Osler, brought greetings from the British Empire and from the Osler Club of London; Dr. Olof Sjöqvist, of Stockholm, who presented a Swedish *festskrift* to Dr. Cushing; Dr. J. F. Fulton, who read extracts from among more than five hundred letters and telegrams received by Dr. Cushing during the day; Dr. W. J. German, who read two letters from among some hundred and twenty received from patients from whom Dr. Cushing had removed meningiomas of the brain, and finally, Dr. Arnold C. Klebs, of Nyon, Switzerland, who came from Europe for the banquet and returned immediately after it was over.

Dr. Louise Eisenhardt then presented the society's gift to Dr. Cushing, which consisted of a specially bound copy of an annotated bibliography of all Dr. Cushing's writings. The bibliography had been prepared by the society as a surprise. Dr. Cushing then responded to the various tributes. His loyal operating room orderly, Adolph, was present at a suitable moment to mop his brow as in the old days in the operating theater.

There were four printed volumes issued in connection with Dr. Cushing's birthday:

1. A *festskrift* from Scandinavian neurologists and neurosurgeons containing 25 papers—all but two in English—issued under the editorship of Professor Herbert Olivecrona of Stockholm as a supplementary volume of *Acta Chirurgica Scandinavica*, 1939, vol. 82, 99–363.
2. A special number of the *British Journal of Surgery* dedicated to Dr. Cushing, containing a detailed report by Mr. William Henderson of the end-results of all Dr. Cushing's operations for pituitary adenomas. The title is as follows: "The pituitary edenomata. A follow-up study of the surgical results in 338 cases (Dr. Harvey Cushing's series)." *British Journal of Surgery*, 1939, vol. 26, pp. 809–921.
3. A special number of the *Yale Journal of Biology and Medicine* containing all the papers read at the meeting and designated "The Cushing Anniversary Volume." It includes 26 papers.
4. An annotated bibliography of all Dr. Cushing's writings, issued by the Harvey Cushing Society. The volume was designed by Mr. Carl P. Rollins, printer, of Yale University, published by Mr. Charles C Thomas, who had issued four of Dr. Cushing's previous monographs, and printed by the George Banta Publishing Company. The title is as follows: "A Bibliography of the Writings of Harvey Cushing Prepared on the Occasion of His Seventieth Birthday, April 8, 1939," by The Harvey Cushing Society, Springfield, Ill., Charles C Thomas, 1939, xvi, 110 pp.

The speeches and extracts from letters and cables will presently be issued as a separate brochure by Mr. Charles C Thomas.

J. F. F.

SCIENTIFIC NOTES AND NEWS

Dr. E. D. Merrill, director of the Arnold Arboretum and administrator of the Botanical Collections of Harvard University, has been awarded the Linnean Gold Medal, given annually by the Linnean Society of London "to an eminent biologist as an expression of the society's estimate of his services to science." He has also received through the State Department the gold medal of the Ministry of Agriculture of the French Republic and the corresponding diploma of the Société nationale d'acclimatation de France. These were conferred "in appreciation of services to French horticulture" at a session of the society held at the Museum of Natural History, Paris, in March.

THE Clement Cleveland Medal for "Distinguished Service to Public Education on Cancer" was presented to Mlle. Eve Curie, daughter and biographer of the late Mme. Marie Curie, at a dinner held on April 18 in the Cosmopolitan Club, New York City. Dr. Francis Carter Wood presented the medal, which was established in 1937 by Mrs. Robert G. Mead in memory of her father, a pioneer of the movement to educate the public in the importance of early diagnosis and prompt treatment of cancer.

DR. ALEXIS CARREL, member of the Rockefeller Institute for Medical Research, was presented on April 13 with the Service Medal of the Rotary Club of New York, "in recognition of a life dedicated to the amelioration of human suffering."

THE Joseph A. Capps Prize in medical research of $400 of the Institute of Medicine of Chicago has been awarded for 1938 to Broda O. Barnes, who graduated from Rush Medical College in 1937, for his paper on "Observations on the Adreno-Genital Syndrome." The prize, founded by the late Dr. Edwin R. LeCount, is awarded annually for the most meritorious investigation in medicine completed by a graduate of a recognized medical school in Chicago within two years after the completion of an internship or of one year of laboratory work.

DR. DAVID SARNOFF, president of the Radio Corporation of America, was among those who received a scroll of honor on April 19 from the National Institute of Immigrant Welfare. The award is given to "distinguished citizens of foreign birth who have made significant contributions to American life."

THE Mittag-Leffler Institute Gold Medal of the Mathematical Institute at Stockholm has been awarded to M. Émile Picard, professor of mathematics in the University of Paris and permanent secretary of the Academy for Mathematical Sciences, Paris.

MAJOR R. LIGHTFOOT, director of the Geological Survey of Southern Rhodesia, has been elected president of the Geological Society of South Africa.

M. BERNARD LYOT, of the Meudon Observatory, has been elected a member of the Section of Astronomy of the Paris Academy of Sciences in succession to the late A. de La Baume Pluvinel.

COLUMBIA UNIVERSITY has conferred the title of professor emeritus in residence on Dr. Charles P. Berkey, geology; Dr. Marston T. Bogert, organic chemistry; Dr. Gary N. Calkins, protozoology; Dr. Bergen Davis, physics, and Dr. Frederick J. E. Woodbridge, philosophy. The title of professor emeritus has been conferred on Dr. Daniel D. Jackson, chemical engineering; Dr. Robert Lewis, otolaryngology; Dr. Herbert B. Wilcox, diseases of children; and Dr. Francis Carter Wood, director of the Institute of Cancer Research.

OVID WALLACE ESHBACH, of the New York office of the American Telephone and Telegraph Company, has been appointed dean of the new Institute of Technology at Northwestern University. He will take up the work at once. The institute will be established under a grant of $6,735,000 from the Walter P. Murphy Foundation of Chicago. It will open in the autumn term of 1940 and will include departments of chemical, civil, mechanical and electrical engineering. It will be conducted on the cooperative plan.

DR. MICHAEL J. ZIGLER has been promoted to a professorship of psychology and Margaret Parker to a professorship of geology and geography at Wellesley College.

DR. ROBERTS RUGH, instructor in zoology at Hunter College, has been appointed associate professor of biology in the Graduate School of New York University.

THE trustees of the Anatomical Journal Trust, the Minot Memorial Fund, have appointed Professor Philip E. Smith, of Columbia University, to be a trustee in place of the late Charles R. Stockard. The other trustees are Professors Bradley M. Patten, University of Michigan, and George W. Corner, University of Rochester. The latter will act as chairman.

DR. CARL J. WIGGERS, professor of physiology of Western Reserve University School of Medicine, has been awarded $4,100 from the John and Mary Markel Foundation. The grant is for a study of the nature of ventricular fibrillation by means of desensitizing the heart.

SIR WILLIAM BRAGG, president of the Royal Society and director of the Davy Faraday Laboratory of the Royal Institution of Great Britain, will speak at Bryn Mawr College on May 4. His subject will be "The Structure of Organic Crystals."

THE fourth Hughlings Jackson Memorial Lecture of the Montreal Neurological Institute was given on April 19 by Dr. Walter B. Cannon, George Higginson professor of physiology at Harvard University. The title of the lecture was "The Law of Denervation." Following the lecture a specially bound copy of the "Selected Writings of John Hughlings Jackson," edited by James Taylor, was presented to Dr. Cannon.

DR. ARTHUR H. COMPTON, professor of physics at the University of Chicago, on April 11 gave a lecture on "Cosmic Rays" before the Society of the Sigma Xi at the Kansas State College, Manhattan. The lecture was a part of the initiation exercises at which twenty-six new members were received.

DR. CARL D. ANDERSON, associate professor of physics at the California Institute of Technology, addressed the Iowa State College Chapter of Sigma Xi on March 30. His subject was "Cosmic Rays and a New Elementary Particle of Matter."

PROFESSOR G. H. PARKER, of Harvard University, lectured on "Modern Views on the Action of the Nervous System" before the ninth annual Connecticut Valley Student Scientific Conference held at Williamstown, Mass., on April 15.

DR. EARNEST ALBERT HOOTON, professor of anthropology at Harvard University, gave in April a series of four lectures before the Wagner Free Institute of Science, Philadelphia, on "The Making and Mixing of Human Races."

THE seventh series of Thomas William Salmon Memorial Lectures was given by Dr. Edward A. Strecker, chairman of the department of psychiatry of the School of Medicine of the University of Pennsylvania, at the New York Academy of Medicine on April 14, 21 and 28. Dr. Strecker's general subject was "Beyond Clinical Frontiers." The individual titles of the lectures were: "The Massive Retreat from Reality"; "Crowd-Mindedness" and "Threat to Our Culture."

PROFESSOR ANTON J. CARLSON, of the Department of Physiology of the University of Chicago, made an address before the Academy of Medicine of Washington, D. C., on April 24, on "Science and the Common Life." He spoke before the Smith-Reed-Russell Society, honorary organization at the George Washington University School of Medicine, on the following day, when his address was entitled "Notes on Medical Education and Medical and Public Health Services in Russia and China."

THE fourth Leo Loeb lecture under the annual lectureship established by the Mu Chapter of the Phi Beta Pi medical fraternity was delivered on April 20 by Professor Soma Weiss, of the Harvard Medical School. The title of the lecture was "Vasomotor Reactions and Circulatory Collapse."

THE American Ophthalmological Society will celebrate its seventy-fifth anniversary on June 7. This is the first society in the United States to be devoted exclusively to ophthalmology.

THE annual Congress of the Society for British Entomology will be held in the Manchester Museum and the University of Manchester from July 15 to 17, under the presidency of Professor W. A. F. Balfour-Browne.

IT is stated in *Nature* that the thirty-seventh annual meeting of the South African Association for the Advancement of Science will be held in East London from July 3 to 8, under the presidency of Professor G. H. Stanley. The British Association Medal for 1938 will be awarded to Miss Jean Murray, of the Division of Plant Industry, Pretoria, for her paper entitled "An Investigation of the Inter-relationship of Vegetation, Soils and Termites." A symposium on "The Need for the Investigation and Conservation of Human Resources in South Africa" is being organized by Dr. E. G. Malherbe, director of the National Bureau of Education and Social Research, Pretoria. Further information can be obtained from the assistant general secretary, H. A. G. Jeffreys, P. O. Box 6894, Johannesburg.

THE sixth International Technical and Chemical Congress of Agricultural Industries will be held in Budapest from July 10 to 20 under the patronage of the Regent of the Kingdom of Hungary. Three divisions have been arranged—(1) general, scientific and industrial studies, with sections of biology, analytical methods and apparatus, agronomy and research in the creation of new agricultural industries; (2) specific industries, including sugar, fermentation, foods, tropical industries and substitutes, and (3) economic studies, legislation and international agreements.

APPLICATIONS for grants from the Cyrus M. Warren Fund of the American Academy of Arts and Sciences should be received by the chairman of the committee, Professor James F. Norris, Massachusetts Institute of Technology, Cambridge, not later than May 15. Grants are made to assist research in the field of chemistry. On account of limited resources, grants to an individual are seldom made in excess of $300. The application should be accompanied by an account of the research to be undertaken, a statement of the sum requested and the manner in which the money is to be expended.

TWELVE fellowships in the medical sciences, including three renewals, for study in the United States and abroad during the year 1939–40, were awarded at the February meeting of the Medical Fellowship Board of the National Research Council, Washington, D. C., of which Dr. Francis G. Blake, Sterling professor of medicine at Yale University, is the chairman. A list of the successful candidates and institutions where they are to work follows: Philip P. Cohen (renewal), University of Sheffield, England; Thomas Harrison Davies (renewal), California Institute of Technology; Victor M. Emmel, Yale University Medical School; Alto E. Feller, the Harvard Medical School; Arden Howell, Duke University; Fremont Ellis Kelsey, University of Pittsburgh; Abe Ravin, the Harvard Medical School; Joseph Shack, the Johns Hopkins University; William M. Wallace, the Harvard Medical School; Wilfred W. Westerfeld (renewal), Eidgenössische Technische Hochschule, Zurich, Switzerland; Richard Winzler, University of Stockholm; William Barry Wood, Jr., the Harvard Medical School.

THE University of Alabama Chapter of the Society of the Sigma Xi was installed on April 4. Dr. Edward Ellery, national secretary of Sigma Xi, gave an address on "The Urge to Know and Academic Freedom," at a special morning convocation. Dr. George A. Baitsell, national president, gave a lecture on "Uniformity in Nature" immediately after the banquet. During the formal installation exercises, the following were elected as officers of the new chapter: *President*, Dr. Emmett B. Carmichael, professor of physiological chemistry; *Vice-president*, Dr. J. D. Mancill, assistant professor of mathematics; *Secretary*, Dr. E. F. Richards, assistant professor of geology, and *Treasurer*, B. W. Gandrud, metallurgist, U. S. Bureau of Mines, Southern Experiment Station, Tuscaloosa.

THE Graduate Science Club of Stanford University was installed as a chapter of Gamma Alpha Graduate Scientific Fraternity on April 14 at the Stanford Union. Dr. Carleton F. Scofield, the national president of Gamma Alpha, was the installing officer. In the evening there was an installation banquet at which many distinguished guests were present.

SIR FREDERICK BANTING has been appointed by the Associate Commission on Medical Research, which is financed by the National Research Council of Canada, to investigate medical research facilities in all parts of Canada. He has completed a survey of the maritime provinces and is expected to report to the associate commission the results of his work this year. The survey was made possible by the aid of the Canadian Medical Association and the Royal College of Physicians and Surgeons of Canada. During the survey of western Canada, Sir Frederick will visit the University of Manitoba, the University of Saskatchewan, the University of Alberta and the University of British Columbia. On his return to eastern Canada, he will consult with Calgary and Regina hospitals and Brandon College authorities.

IN compliance with the requirements of a gift under the will of the late Francis Amory, of Beverly, Massachusetts, the American Academy of Arts and Sciences announces the offer of a septennial prize for outstanding work with reference to the alleviation or cure of diseases affecting the human genital organs, to be known as the Francis Amory Septennial Prize. The prize may be awarded to any individual or individuals for work of "extraordinary or exceptional merit" in this field. In case there is work of a quality to warrant it, the first award, which will exceed ten thousand dollars, will be made in 1940. It may be given in one or more awards. Requests for further information should be addressed to the Amory Fund Committee, care of the American Academy of Arts and Sciences, 28 Newbury Street, Boston, Massachusetts.

THE Dazian Foundation for Medical Research recently began to function. In accordance with the will of Henry Dazian, the foundation is prepared to award fellowships to individuals holding the degree of doctor of medicine, for the purpose of post-graduate study and research, and grants to laboratories, hospitals and similar institutions, for research in medicine. Applications and inquiries should be directed to the Secretary, 180 East 64th Street, New York, N. Y. Members of the board of directors are: Alexis Carrel, William W. Cohen, treasurer; Philip Finkle, secretary; Emil Friedlander, assistant secretary and treasurer; Emanuel Libman, president; Harrison, S. Martland, Alfred L. Rose, Israel Strauss, vice-president, and Harold Williams.

DISCUSSION

ON THE PATH OF THE FIREFLY WHILE PERIODICALLY FLASHING[1]

A GREAT deal has been written on the life history of the fire-fly, and many, including physicists and chemists, have speculated on the efficient light that these small insects can turn on and off at will. It is not the writer's intention to say anything regarding the former, since he is not a zoologist, or anything regarding the chemical and physical aspects in the production of the light, but he does wish to call attention to one of the firefly's instinctive qualities, namely, to its path in flight while periodically flashing. A fairly complete search through the literature for discussions on this point has been made without much success.

The writer was reared on a farm in the "Big Woods" of northwestern Ohio at a time when nature there was still in its unspoiled state, for three fourths of the area was forest. He remembers as a boy a field of about ten acres, recently cleared, lying along side of the road and adjacent to his father's place. We often drove along this road at dusk and with wonderment observed the myriads of fireflies moving about over this newly cleared, but not yet broken, field. The soil conditions, the humidity, the decaying stumps and new undergrowth must have been favorable for their existence and propagation. It was in this field that the writer first observed the actual path that the firefly traces in flight while flashing periodically. He has observed this same characteristic path down through the years, and only last summer checked it again. It should be stated that numerous persons have been interviewed, including zoologists, chemists, physicists, physiologists and psychologists, and he has the first one yet to find who definitely stated having noticed the recurrent irregularities in the flight of the firefly at the time of flashing.

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[1] Read before the Zoological Section of the Illinois State Academy of Science, May, 1938, and to be printed in the forthcoming *Transactions* of the academy.

A brief description and discussion follow: The firefly on its twilight excursions flies for the most part in a horizontal direction. Take a windstill evening. A trace of its path viewed horizontally and from the side is shown in Fig. 1. The portions *a*, *b* and *c* represent the more or less undulating stretches of the flight of the fly, while m_1 m m_2 the path during a "flash" and n_1 n n_2 the path during the next following flash. As viewed from the side the fly on approaching m_1 slows down appreciably (seeming to waver slightly as though in an effort to stop) but maintains its flying level. The light is then turned on, and simultaneously the firefly drops visibly from its horizontal flight, but acceleration at once ensues, the downward duck is quickly arrested, followed by an upward spurt, as shown by the trace m m_2 in the figure. On reaching m_2, at a distance of from 5 to 15 cm from the beginning of the flash, the light is suppressed and simultaneously the flight is again slowed down. The fly seems to waver, as in an effort to regain its equilibrium, before continuing its more or less undulatory flight along *b*, reaching n_1, When the luminous path cycle is repeated.

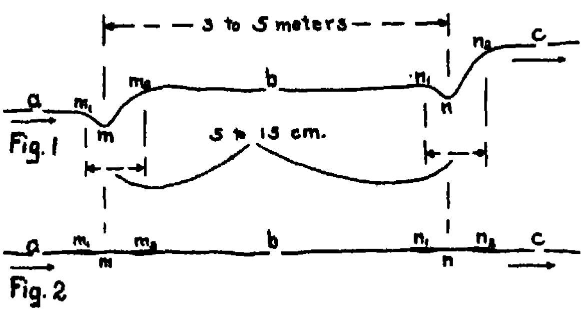

FIG. 1. Side elevation. Two flashes, m_1 m m_2, and n_1 n n_2, are shown. FIG. 2. Top plan, looking down. Wavering shown by thickened line.

Looking down from above, Fig. 2, the path discloses no outstanding characteristics. The direction of flight is pretty much straight ahead, but on close observation there may be at times signs of wavering at the points m_1 and m_2 and also at n_1 and n_2, referred to above and shown in Fig. 2 by the thick portions of the line. Observations from above reveal the accelerations in flight, both positive and negative, over the flash period. These observations are not easy to make, as one can well imagine.

Speculating on the evidence revealed by the foregoing, it seems that the system (the firefly) may be thought of as containing stored energy under control of the insect for both maintaining flight and producing flashes of light. The fly now contemplates a flash as it approaches, say, m_1. On turning on the light (drawing energy from the common source) the attendant "overload" causes the mechanism necessary for sustained flight to slow down and the fly drops slightly. Simultaneously extra stores of energy are tapped, the flight mechanism responds, the illumination brightens and the insect speeds upward, in its endeavor to overcome the falling tendency, and reaches the point m_2, having thus described the smooth path m_1 m m_2. At m_2 the energy for the production of the light is shut off, and with it, doubtless, some that was needed in maintaining flight. The flight mechanism again slows down, the fly may waver as though to regain its balance (Fig. 2), and then starts off at reduced speed over the routine flight between flashes, while energy for the next flash is generated (chemically or otherwise) en route. That considerable energy is expended in the production of the flash and must be renewed (between flashes) is evidenced by the fact that if the fly is caused to emit light continuously its brightness dims perceptibly with time.

The above are the writer's observations, extending over a long period. Fig. 1 depicts the path quite accurately. Have other observers noticed similar persistent irregularities?

CHAS. T. KNIPP
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PATENTS FOR ACTS OF NATURE

Now that Senator Joseph G. O'Mahoney and his colleagues of the Temporary National Economic Committee have apparently concluded their series of snapshot exposures of the iniquities of patent-owners who pool their patents to create wicked monopolies and who exercise "dog in the manger" control of inventions by "pigeonholing" the patents upon them, let them investigate a real abuse of our patent system—patents for true chemical compounds—surely the most preposterous patent monopolies that have ever been foisted upon the public with, alas, the sanctions of some of the courts.

All patent monopolies in this country derive from that provision of the Constitution which reads:

> Congress shall have Power. . . . To Promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries.

As early as 1790, Congress, pursuant to the grant of this express power, enacted legislation authorizing the granting of patents for arts, manufactures, engines, machines and devices, and improvements upon such subject-matters, but this legislation soon proved to be far from satisfactory. So, three years later, Congress enacted the superseding Patent Act of 1793, which authorized the granting of patents for arts, machines, manufactures and compositions of matter, and improvements upon such subject-matters, and thereby established those categories of patentable inventions which have persisted unchanged and unreconsidered in our statutory patent laws for the past one hundred and forty-six years. Now while true chemical compounds indubitably are compositions of matter, they constitute a very special kind of compositions of matter, for they are unique molecularly-homogeneous substances of invariant compositions and fixed properties, unalterable by man; but in 1793, not even the most astute chemists (let alone Congressmen) then living could be certain of these facts, because they were not then known, for they were first established experimentally during the years 1801–09 by Proust in his controversy with Berthollet.

By 1841 or earlier, the courts had wisely decided that the word "Discoveries" in the Constitutional provision means merely "inventions"; and hence, only "inventions" are patentable. Now an "invention" is a specifically human affair: it is necessarily a creating or contriving by man—some thing or some action or series of actions performable upon materials that man can, and does, make or perform—in short, a purely human accomplishment: it is, above all, *not* something that nature, and only nature, can create. In other words, the "inventive-content" of any alleged "invention" is, and can never exceed, the contributions, mental and physical, made by man in the sum-total of the phenomena connoted by the alleged "invention"; for, to the "inventor" are likewise applicable those discerning words wherewith Anatole France characterized the "scientist" when he wrote:

> Le savant multiplie les rapports de l'homme avec la nature, mais lui est impossible de modificier rien la caractère essentiel de ces rapports.

The U. S. Supreme Court heavily underscored this conception of "inventions" in 1852 by intimating that "principles of nature", including properties of matter such as the property of plasticity possessed by lead, are definitely unpatentable. Surely there can be no disagreement with these views, inasmuch as it would be most absurd for the Federal government to grant patents for "principles of nature", *i.e.*, phenomena of nature which man had stumbled upon and had not, nor could have, created or contrived, such as the inherent properties of substances. And so consistently have the courts subscribed to this doctrine of the unpatentability of properties of matter that they have refused to sustain patents for the property of ductility possessed by pure tungsten, pure uranium and pure vanadium.

What, then, is most astounding is the fact that the U. S. Patent Office has granted, and certain of the lower Federal courts have sustained, patents for true chemical compounds themselves. Thus, in 1902, the U. S. Circuit Court of Appeals for the Third Federal Circuit sustained U. S. Patent No. 400,086 for acetylphenetidine (phenacetin), and, in 1910, the U. S. Circuit Court of Appeals for the Seventh Federal Circuit sustained U. S. Patent No. 644,077 for acetylsalicylic acid (aspirin). As precedential cases, these two decisions unquestionably and most unfortunately have had the effect of apparently warranting the validities of the enormous number of patents for true chemical compounds, as such, some of the better known of which are:

U. S. Patent No. 782,739	for Veronal
U. S. Patent No. 812,554	for Novocaine
U. S. Patent No. 986,148	for Salvarsan
U. S. Patent No. 1,025,872	for Luminal
U. S. Patent No. 1,280,119	for Tryparsamide
U. S. Patent No. 1,514,573	for Amytal
U. S. Patent No. 1,533,003	for Mercurochrome
U. S. Patent No. 1,649,670	for Hexylresorcinol
U. S. Patent No. 1,825,623	for Nupercaine
U. S. Patent No. 1,921,424	for Benzedrine

But *are* these decisions sound? *Of course not!* If there is one thing on this earth that man can not "invent", it is a true chemical compound, because every true chemical compound, as such, is nothing more or less than an ensemble of unpatentable properties of matter, created and quantitatively embodied in tangible substance solely by nature. You can put together mutually reactive substances, and that "putting together" may well constitute a patentable process, but what you get by, and out of, the interactions of the juxtaposed substances depends wholly upon the volition of nature. Nature, and nature alone, fixes the structure, the composition and the inherent properties of every true chemical compound that is producible by processes devised by man, and neither you or I nor any one else can alter any one of them. Obviously then, no true chemical compound, as such, can be an "invention".

When Germany enacted her statutory patent laws in 1877, just seven years *after* the last not-too-casual overhauling of our statutory patent laws by Congress, she accorded full recognition to the fact that true chemical compounds, as such, can not be "inventions" by extending to them, not intrinsic patent protection, but patent protection merely to the extents that they were products of patentable processes. Hence, in Germany today, owners of patents for non-equivalent processes for producing the same true chemical compound can, each and every one, produce that true chemical compound without let or hindrance by the others. In 1919, England adopted in her statutory patent laws precisely the same attitude toward true chemical compounds. But in this country, under the aforementioned decisions of the lower Federal courts, the man who first produces a novel true chemical compound can acquire by a patent so absolute a monopoly upon that true chemical compound that for seventeen years he can prevent any one from producing it by any process whatsoever, including all processes which are entirely unlike his own process. Surely nothing could be more irrational than the fact that upon producers of true chemical compounds, including medicinals and pharmaceuticals such as those listed above, were, and are, bestowed the tightest patent monopolies on the face of the earth, founded, mind you, upon subject-matters which can not be "inventions" of man, but which are "inventions" of nature alone! And since such absolute patent monopolies undoubtedly discourage the developments of novel processes for the productions of patented true chemical compounds, they can hardly be said "To Promote the Progress of Science and Useful Arts."

Fortunately, the U. S. Supreme Court has never explicitly affirmed any one of these egregious decisions of the lower Federal courts, nor has it ever categorically declared true chemical compounds, as such, to be patentable, so that a single decision of that tribunal will suffice to dispose of these "earth and a slice of Heaven" patent monopolies. But an amendment of our statutory patent laws, expressly excluding from intrinsic patent protection all true chemical compounds, would accomplish the same result just as effectually and more expeditiously.

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SPACE PERCEPTION BY RADIO

MOST people who have bought an improved radio junk their old one. That is not always wise, as will be shown. First find out whether your old radio amplifies better the low or the high pitches prevailing in music. Then adjust your new radio, which often permits it, so that the other pitches are favored by its amplification. Now, if you have a very large room, put one radio in one corner and the other in the diagonal corner, and seat yourself near the middle. If you have only small rooms, choose two with a connecting door open, place your radios as far apart as possible and seat yourself near the door in the larger of the two rooms. A little experimenting may be called for. You will more or less readily observe a strange effect. Close your eyes or simply forget what you actually see with them. It seems that you have before you the orchestra with the musicians so seated that the highest pitched instruments are on one side of the stage, the lowest pitched on the other side, and the middle instruments ranged between accordingly.

If it is a mixed chorus you are listening to, the female singers seem to be on one side of the stage, the male singers on the other side. Or if it is a duet of a soprano and a basso of the Metropolitan Opera, you seem to be located between the woman and the man. In some cases, though, the peculiar voice quality of the basso singer may diminish the strength of this spatial illusion by "splitting," so to speak, the basso's voice into a lower and an upper component. It goes without saying that you can have the effect only if you have two fairly good ears. If you are deaf or hard of hearing on one of your ears, you will try in vain.

The whole effect would be a very small *esthetic* addition, if any, to what you can get with a single radio, although in any case it would be interesting enough. But there is something else to be mentioned. As soon as you begin to differently *localize* the higher and lower sounds, you notice that the ease with which you *analyze* the compound sound is enhanced, the keeping apart of the components of any chord in your musical apprehension is a matter of less effort to your attention. When the tones say to you, "I am here and I am there" you become more readily aware of their separate existence. Now, whoever knows anything about the psychology of music knows that the ability to analyze, to overcome the fusion to which the simultaneous tones are subject in the untrained listener, is one of the greatest assets for the appreciation of our modern highly complex music. The method above described is therefore a distinct aid for getting the maximum of esthetic appreciation. If you have two good ears, why not utilize fully the possession of both?

MAX F. MEYER

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CORAL GABLES, FLA.

MICROBIOLOGY OF COAL

A STUDY of the biological decomposition of coal has been under investigation in the Departments of Fuel Technology and Bacteriology of the Pennsylvania State College for several months to determine the types of microorganisms that can decompose coal, to study the changes occurring in solutions containing humic acids prepared from bituminous coal and to examine the technical and economic aspects of such changes.

While various investigators have established the presence of microorganisms in coal, an appreciable consumption of coal substance by microbial activity has not previously been recorded in the scientific literature.

For the present experiments coal solutions proved to be an excellent substrate for cultivating bacteria. These solutions were prepared from the alkali-soluble "humic acids" resulting from the oxidation of bituminous coal. The basic substrate for the biological experiments was a 2 per cent. humic acid solution. Microorganisms of the order of true bacteria, fungi and actinomyces were found to grow on liquid and solid humic acids media. The organisms utilized the coal substance for their food and energy requirements up to the point where almost the entire carbonaceous material was consumed. By bacterial action over a period of at least six weeks, the originally dark-brown solutions became colorless, indicating that the humic acids were completely destroyed.

A preliminary chemical investigation has shown that the breakdown of the coal substance does not yield volatile compounds, such as methanol or acetic acid but gives rise to non-volatile acids, which are now under investigation.

It is believed that the products formed by the activities of microorganisms on coal solutions may prove of economic value. In addition, a knowledge of the type and the mechanism of metabolism of such microorganisms will assist in a better understanding of the decomposition of humic acids in soils.

FRIEDA WEINSTOCK FUCHS
THE PENNSYLVANIA STATE COLLEGE

SOCIETIES AND MEETINGS

THE FIRST SOUTH AMERICAN BOTANICAL CONGRESS

THE first South American Botanical Congress held its meetings at Rio de Janeiro, Brazil, during the week from October 12 to 19, 1938. The congress was the result of efforts made by some of the leading botanists of South America to bring about such a gathering in order that a definite program of cooperation in botanical research could be initiated for the several South American nations and colonies.

Although the congress was specifically for South American botanists, other nations were invited to send botanical representatives, and Cuba, England, The Netherlands, Germany and the United States were represented. Chile, Peru, Paraguay and British and French Guiana were not represented by botanical delegates, but were represented at the general meetings by their embassies.

The greater part of four days was occupied in the reading and discussion of well over a hundred technical papers on various botanical and agricultural subjects. The papers given were about equally divided in the following fields of research: Systematic Botany, Microbiology, Morphology, Physiology, Genetics, Phytogeography and Applied Botany. Since the time was short and the papers numerous, the various fields of work were discussed in concurrently running sections and the delegates attended the sections which dealt with their particular field.

Two days of the congress were devoted to trips out of the city in order that visiting delegates could see some of the distinctive features in the nearby country. One of the trips was to the beautiful resort area about the town of Petropolis, which lies well up in the mountains some three hours' drive by car on an excellent highway from Rio de Janeiro. Here the delegates caught glimpses of virgin forest and made a highly interesting visit to a large private display of orchids. The officials of the town of Petropolis were hosts at a luncheon for the delegates. The other trip was a more extensive journey by rail to view the "restinga" vegetation of the seacoast.

Dr. P. Campos Porto, director of the Biological Institute and Botanic Garden at Rio de Janeiro and also president of the Committee of Organization for the congress, was host at a garden party for the delegates. The setting was of exquisite beauty, in the Botanic Gardens, with Royal palms and mountains for background and countless orchids blooming on all sides. Leading Brazilian artists contributed to the entertainment with folk dances and songs as well as classical music.

Two plenary sessions of the congress were held, during which several important resolutions were approved for recommendation to the respective governments. The following, of general interest, may be mentioned here:

To establish regional botanic gardens. Each country to choose areas within its limits to set up arboreta or botanic gardens where the representative flora of the region may be studied. These botanic gardens will form a South American System for exchange of information between the various regions of South America.

To establish a South American Botanical Bureau. Each country will establish a central bureau, which will be charged with the task of bringing together botanical information pertinent to that country. It is intended that the bureaus in each country will eventually become federated for the whole of South America and that eventually there will be established a central bureau for the continent.

To supervise and regulate exploration. Each country shall recommend that its government promulgate regulations so that such exploration can not take place without the previous knowledge and permission of the government. Duplicates of all collections shall be left in the country and unique or rare collections shall have their export forbidden.

At the opening meeting permanent officers were elected for the years 1939 to 1942. They are as follows: *President,* Dr. Alberto Castellanos, Museum of Natural History, Buenos Aires, Argentina; *Vice-president,* Dr. Fernando Rosa Mato, Museum of Natural

History, Montevideo, Uruguay; *Secretary-General,* Dr. Fernando Silveira, Institute of Education, Rio de Janeiro, Brazil. It was proposed by the delegation from Argentina that the Second South American Botanical Congress be held at the Institute Miguel Lillo at Tucuman, Argentina, in 1942. This was unanimously approved.

Brazil, famous for its generous hospitality, surpassed even this reputation as host to the delegates of the congress, and congratulations should be extended to Dr. Campos Porto and the Committee of Organization for a well-planned and well-executed program.

C. O. Erlanson

U. S. Department of Agriculture

SPECIAL ARTICLES

SEX MECHANISM IN POLYPLOIDS OF MELANDRIUM[1]

Last spring a series of experiments designed to determine the effect of polyploidy upon sex in various dioecious plants was undertaken. A preliminary report on this investigation was given in December.[2] This present paper is a summary of work on colchicine-induced polyploids of a white-flowered race of *Melandrium dioicum.*

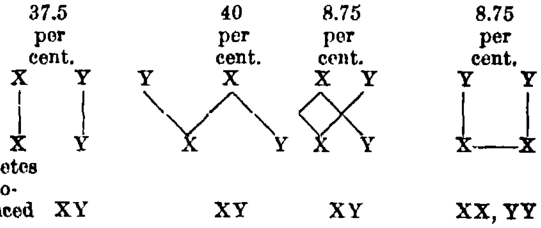
Fifteen out of 19 seed-treated plants examined proved to be entirely or partly 4n (8 XXYY males and 7 XXXX females). These plants were intercrossed and a second generation of over 100 3*n* and 4*n* plants was grown. There is enough difference in size between the sex chromosomes and autosomes and between the X and Y to determine the chromosomal constitution of a plant by cytological methods. The following is a tabulation of sex and chromosome constitution in second generation plants:

Type	Chromosomal constitution*	Number of plants and sex
2n	2A + XX	17 ♀
(control)	2A + XY	20 ♂
3n	3A + XXX	1 ♀
	3A + XXY	4 ♂ ; 1 ± ☿
4n - 1	4A + XXX	1 ♀
	4A + XXY	1 ♂
4n	4A + XXXX	3 ♀
	4A + XXXY	65 ♂ ; 3 ± ☿
	4A + XXYY	2 ♂
4n + 1	4A + XXXXY	1 ☿
	4A + XXXYY	3 ♂

* Irregularities in number of autosomes have been observed in plants in this table but for simplicity have not been indicated in the tabulation.

Among the 2n plants there are 20 males to 17 females. The preponderance of males among the 4n plants (67 to 3) is due to the fact that the XXXY individuals are very numerous, as Muller[3] and Westergaard[4] have predicted, and because XXXY plants are male. (Three XXXY male plants occasionally bear hermaphroditic (☿) blossoms; the 65 other plants of this genotype are vigorous, fertile males.)

Peculiar conjugation and segregation of the sex chromosomes is responsible for the large number of XXXY plants. The following types of association have been observed at MI in 80 P.M.C. of 2 of our XXYY males, in addition to 5 per cent. of infrequent types:



Ninety per cent. or more of the gametes produced by the original 4n males (XXYY), therefore, should be XY, and when these unite with the XX gametes from the female, the excess of XXXY individuals should result. Westergaard[4] has observed the X - X and Y - Y conjugation to be the most frequent type; he has not reported quadrivalent association.

In a state of nature the excess of the XXXY males would likely lead to their fertilizing a large majority of the 4n females. Since the XXXY males are completely fertile and produce XX and XY gametes, such hybridization should give rise to a population of equal numbers of 4n females of the constitution XXXX and of 4n males of the constitution XXXY (aside from occasional males with a few hermaphroditic flowers). Thus a new 4n race with approximate numerical equality of males and females should be possible. The conclusions of Muller[3] and Dobzhansky[5] that doubling of chromosomes could not be a factor in evolution of dioecious forms therefore appears unfounded.

In the plants with three sex chromosomes of one size and the fourth of a different size, the 3 similar chromosomes must be X, for it is impossible to obtain an

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[1] This investigation has been supported in part by a grant from the Carnegie Corporation to the Carnegie Institution of Washington.

[2] H. E. Warmke and A. F. Blakeslee, *Genetics,* 24: 88, 1939.

[3] H. J. Muller, *Amer. Nat.,* 59: 346, 1925.

[4] M. Westergaard, *Nature,* 142: 917, 1938.

[5] T. Dobzhansky, "Genetics and the Origin of Species," Columbia Univ. Press, pp. 219, 1937.

XYYY individual from the cross XXXX by XXYY. It is thus possible in this material to measure the sex chromosomes *within a single cell* and determine accurately whether X or Y is the larger. In all our XXXY plants, the three similar chromosomes are small, and the single remaining one is large. Our findings agree, therefore, with those of Blackburn,[6] that the Y is the larger member of the sex pair, and disagree with the observations of Winge,[7] Meurman,[8] Breslawetz,[9] and Westergaard,[4] who report the X to be the larger. It is possible, of course, that our material may have a different chromosome constitution from the material investigated by these latter workers.

The plants 4A + XXXY (male) and 4A + XXX (female) differ genetically only in the absence of a Y chromosome in the latter. We may therefore conclude that the Y chromosome carries male-determining elements, contrary to the situation in *Drosophila*[10] and *Rumex*,[11] where the Y chromosome has been shown to play no role in primary sex determination. In the 3A + XXY and 4A + XXXY types, one Y is usually sufficient to outweigh the 2X or 3X chromosomes and to produce maleness. One Y apparently can not completely outweigh 4 X's in the XXXXY individual, however, and a hermaphrodite results.

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BROAD PROTECTIVE ACTION OF RABBIT ANTIPNEUMOCOCCUS SERUM IN RATS

Following the work of Tillett (1927), who showed non-type-specific pneumococcus active immunity in rabbits, increasing attention has been paid to this problem, notably by Bailey (1931–1933), Day (1935), Harley (1935) and Dubos (1938).

During the past year we have prepared various type-specific antipneumococcus sera in rabbits, as Goodner and his associates have described. We have also used, in addition to the S forms, an R form known as DRI, as well as certain Forssman and other control antigens.

In view of the possible value of heterophile antibodies in rabbit antipneumococcus serum, it appeared advantageous to use white rats as test animals for the determination of the protective efficacy of the various sera.[1]

Passive protection tests were conducted by injecting suitable dilutions of antiserum and culture together intraperitoneally into white rats of from 90 to 100 grams weight. Varying doses of serum were used, each serum dose being tested against a series of chilled decimal dilutions of broth culture which had been incubated for six hours.

While more complete details will appear in a later report, certain preliminary observations should be reported. They are:

(1) Combined horse and rabbit antipneumococcus serum is not as effective as rabbit serum alone, even though the combined serum contains as many as five to ten times the heterophile antibody titer of the rabbit serum.

(2) Type specific rabbit sera show considerable heterologous protection—notably types II and V.

(3) Rabbit serum prepared from a rough variant of a type I strain—DRI—gives marked protection against at least seven types of pneumococci.

TABLE 1

Pneumococcus Rat Protection Tests

Pneumococcus culture (cc.)	DRI rabbit antipneumococcus serum B-4651 against pneumococcus types:																											
	I				II				V				VIA				VII				VIII				XIV			
	0.1 cc. serum	0.01 cc. "	0.001 cc. "	Control	0.1 cc. serum	0.01 cc. "	0.001 cc. "	Control	0.1 cc. serum	0.01 cc. "	0.001 cc. "	Control	0.1 cc. serum	0.01 cc. "	0.001 cc. "	Control	0.1 cc. serum	0.01 cc. "	0.001 cc. "	Control	0.1 cc. serum	0.01 cc. "	0.001 cc. "	Control	0.1 cc. serum	0.01 cc. "	0.001 cc. "	Control
10^{-1} . .	S	S	D	D	S	D	D	D	S	D	D	D	D	D	D	D	D	D	D	D	S	D	D	D	D	D	D	D
10^{-2} . .	S	S	S	D	S	D	D	D	S	D	D	D	S	D	D	D	S	D	D	D	S	D	D	D	S	D	D	D
10^{-3} . .	S	S	S	D	S	S	D	D	S	S	D	D	S	S	D	D	S	D	D	D	S	D	S	D	S	S	D	D
10^{-4} . .	S	S	S	D	S	S	D	D	S	S	D	D	S	S	D	D	S	S	D	D	S	D	D	D	S	S	D	D
10^{-5} . .	S	S	S	D	S	S	S	D	S	S	S	D	S	S	D	D	S	S	D	D	S	S	S	D	S	S	S	D
10^{-6} . .	S	S	S	D	S	S	S	D	S	S	S	D	S	S	S	D	S	S	S	D	S	S	S	D	S	S	S	D
10^{-7} . .	–	–	–	S	–	–	–	S	–	–	–	D	S	S	D	D	S	S	D	D	–	–	–	S	S	S	S	D
10^{-8} . .	–	–	–	–	–	–	–	–	–	–	–	D	–	–	–	S	S	S	S	D	–	–	–	–	S	S	S	D

S = survival; D = dead; – = not tested.

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[1] We are indebted to Dr. J. Bronfenbrenner, Washington University School of Medicine, St. Louis, for the suggestion that white rats are more appropriate test animals for antibody of rabbit origin than rabbits, as used in our former experiments.

Table 1 shows the results of pneumococcus rat protection tests with DRI rabbit antiserum B-4651 against culture types I, II, V, VIA, VII, VIII and XIV. It is observed that the DRI antiserum gives marked cross-immunity against all the types of pneumococci used.

It appears that rat protection tests show wider non-type-specific action of rabbit antipneumococcus serum than do mouse protection tests. Proper selection of culture as antigen contributes to the preparation of broad coverage rabbit antiserum. Just as heterophile antibodies can not be produced by the immunization of horses, it likewise appears that other antigenic components of the pneumococcus engender better response in the rabbit than in the horse. While heterophile antigen and antibody play a part in selection of culture and production of antiserum, it is evident that other factors likewise are of importance. More appropriate terms for use in discussing the broad coverage antipneumococcus serum may well be "somatic antigen" and "somatic antibodies."

On the basis of the results obtained in rat protection tests with DRI serum, the possibility of the development of a breed coverage antipneumococcus serum sufficiently high in "somatic" (species specific) antibodies to be of therapeutic value is indicated.

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THE AVAILABILITY OF MANGANESE IN AVIAN DIGESTION

THE perosis-aggravating action of certain calcium and phosphorus salts has long been known, but no explanation for this action has been advanced. The great contrast between the efficient utilization of manganese injected peritoneally[1] and the inefficient utilization of the manganese in the diet, particularly in the presence of high levels of calcium and phosphorus,[2] suggested that in the latter case the manganese may be rendered unavailable due to reactions within the intestinal tract. The fact that tri-calcium phosphate is dissolved in the upper part of the digestive tract, and is reprecipitated in the lower part, suggested that such an action might be responsible for rendering manganese unavailable through either adsorption or chemical combination.

This hypothesis was tested *in vitro* by precipitating calcium phosphate from solutions containing calcium, phosphate and manganous ions in known amounts approximating the concentrations previously used in producing perosis in this laboratory. Analyses of the precipitate, filtrate and washings showed that the manganese was carried down quantitatively by the calcium phosphate precipitate.

These results were substantiated by *in vivo* experiments. Dialysis of the contents of the digestive tracts of White Leghorn pullets showed that manganese in the digestive tract, in the excreta and even in the ration is rendered markedly less diffusible by the addition of excessive steamed bone meal to the diet. It has also been observed in this laboratory that as little as 0.17 per cent. of ferric citrate added to the basal diet caused an increase in the severity of perosis. It was observed *in vitro* that ferric chloride solution, when boiled with a known concentration of manganous ions present, allowed to pass through the colloidal state and precipitated by neutralizing with sodium hydroxide, removed the manganese quantitatively from solution.

It therefore appears that the perosis-producing action of calcium phosphate and of ferric citrate is due at least in a large part to the removal of manganese from solution in the intestinal tract, either by adsorption or chemical combination. This would also explain the perosis-aggravating action of calcium carbonate, since the presence of this compound in excess favors the formation of tri-calcium phosphate in the digestive tract. On the other hand, phosphoric acid and its monosodium and disodium salts, when added to a diet relatively low in calcium, would not tend to form tri-calcium phosphate. Consequently, the addition of these compounds to the diet should not increase the severity of perosis, and such has been shown to be the case.[3,4]

It would seem possible that the interference of calcium salts with iron assimilation,[5] the greater requirement for iodine on a high-calcium diet and other similar instances might prove to be explainable on a like basis.

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MOVEMENT OF RADIOPHOSPHORUS IN BEAN SEEDLINGS[1]

BEAN seedlings (var. Red Mexican) were allowed to grow for varying lengths of time in a nutrient solution containing radiophosphorus (obtained through the courtesy of E. O. Lawrence) at the approximate concentration of 3.5 uc/cc. The bean seedlings had been previously grown without phosphorus, and at the time of use gave slight evidence of phosphorus deficiency by the dark color of the leaves. When placed in the solution containing radiophosphorus, the opposite leaves and the first alternate leaf appeared fully mature. The third alternate leaf was just unfolding.

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[1] M. Lyons, W. M. Insko and J. H. Martin, *Poultry Science*, 17: 12, 1938; C. D. Caskey and L. C. Norris, *ibid.*, 17: 438, 1938; A. C. Wiese, B. C. Johnson, C. A. Elvehjem and E. B. Hart, SCIENCE, 88: 383, 1938.

[2] C. D. Caskey and L. C. Norris, *Poultry Science*, 17: 438, 1938; A. C. Wiese, C. A. Elvehjem and E. B. Hart, *ibid.*, 18: 33, 1938.

[3] Unpublished results, Colorado Agricultural Experiment Station.

[4] P. J. Schaible, J. M. Moore and R. A. Conolly, *Poultry Science*, 12: 324, 1933.

[5] S. W. Kletzien, *Jour. of Nutrition*, 15: 6, 1938.

[1] The writer wishes to express his appreciation to the National Research Council for aid in this project, also to Drs. E. O. Lawrence and J. H. Lawrence for the sample of radiophosphorus.

The plants were placed, one after another, in the radiophosphorus containing nutrient solution. After the required interval of time the plant was removed, the roots carefully washed and the plant dissected and placed in the drying oven. When thoroughly dry the parts were ground to a fine powder and samples weighed for analysis. Each sample was placed in a thin Cellophane (du Pont #3100) cone, which was mounted immediately above the sensitive window of a Geiger counter. The Neher-Harper "High Speed Geiger-Counter Circuit"[2] in connection with "A Direct-Reading Counting Rate Meter for Random Pulses"[3] was used for detecting radiophosphorus in the plant samples. The results are shown in Table I.

TABLE I

DISTRIBUTION OF RADIOPHOSPHORUS IN VARIOUS PARTS OF BEAN SEEDLINGS

Length of time in solution	48 hrs.	24 hrs.	2½ hrs.
Mg. of sample used	4 mg.	10 mg.	10 mg
	Counts/min.	Counts/min.	Counts/min.
Roots	2,364*	1,968	1,092
Hypocotyl	804	744	228
Stem		468	
Opposite leaves	1,104	504	144
First alternate leaf	1,934	888	204
Second alternate leaf	2,124	1,380	240
Third alternate leaf	2,364*		216
Background	36		

* Counter reached end of scale. True value slightly higher.

It was possible, under conditions of the experiment, to detect radiophosphorus in the uninjured plant by moving the shielded counter tube over the leaves and stem. In order to get away from stray radiation, the following technique was adopted.

Discs of fresh leaf tissue were cut from a plant which had been in the radiophosphorus containing nutrient solution for two and one half hours. They were held over the sensitive window of the Geiger counter. A lead shield with a circular hole 7.5 mm in diameter was used to determine the area of leaf tissue exposed to the sensitive window of the counter tube. The results are shown in Table II.

TABLE II

DISTRIBUTION OF RADIOPHOSPHORUS IN FRESH LEAF TISSUE

	Counts/min.	Distance from base of hypocotyl
Opposite leaves	10	18.0 cm
First alternate leaf,		
tip leaflet	46	25.5 "
lateral leaflet	54	23.4 "
Second alternate leaf,		
tip leaflet	20	22.3 "
lateral leaflet	62	20.6 "
Third alternate leaf,		
tip leaflet	38	18.7 "
lateral leaflet	33	17.8 "
Background	36	

The results indicate that phosphorus may be absorbed by the apparently uninjured roots of phosphorus-deficient plants and transported at a rate exceeding 10 cm/hr. From the distribution of radiophosphorus in the plant it appears that movement in the aerial parts is dependent on the transpiration stream, and that the "excretion" of phosphorus into the xylem occurs only after considerable accumulation has taken place in the living cells of the root. Detailed results will be published elsewhere.

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[2] H. V. Neher and W. W. Harper, *Phys. Rev.*, 49: 940, 1936.

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THE NATIONAL ACADEMY OF SCIENCES[1]

ADDRESS OF THE PRESIDENT[2]

THE academy has adhered very consistently since its incorporation to the principle that the primary consideration for membership is convincing evidence, by scholarly character and productiveness, of devotion to the fundamental principles of science and the scientific way of knowledge, which are the sources of the discoveries and inventions that have transformed the social and economic conditions of modern life. There is no danger that we should depart from these principles. But it should be widely known that we fully recognize the social, economic and national responsibilities that rest upon us, and that we are making every effort to discharge these responsibilities. The academy occupies a very special position of responsibility in the relations between science and public affairs.

The academy itself is a small body compared with the great body of professional scientific men in the universities and colleges, in the schools of technology and medicine, in the engineering profession and in medicine, in the research institutes, in government service and in the industrial research laboratories of the country. The academy took a great step forward in the way of wider representation when it organized the National Research Council in 1916 at the request of President Wilson. This body is defined legally as an agency of the academy, but it is much more than that in practice: it is a sister body, possessing a large measure of independence, with which the academy cooperates harmoniously and whole-heartedly in the carrying out of our public relations.

We are bound together most closely not only in administrative ways, but also in spirit and purpose. The overlapping membership is numerous, but the National Research Council has much greater latitude than the academy in the selection of members, all of whom receive their formal appointments from the academy. Through the National Research Council we maintain close relations with the national scientific societies, the members of which in their several degrees represent the institutions and professions to which the great body of scientific men are attached. The influence of the academy reaches out into all the country.

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[1] Meeting in Washington, D. C., April 24, 25 and 26, 1939.

[2] Given at the annual dinner for the presentation of medals, April 25.

The Government of the United States recognized the significance of science to society long before our industrialists. You will find this foreshadowed in the words and acts of Washington and Jefferson, and in the early establishment of research in the scientific bureaus of the government. The incorporation of this academy in 1863 was, indeed, not possible until much progress had been made in this direction. But in the early years of my apprenticeship in the last decade of the nineteenth century, science and industry were hardly yet on speaking terms. Certain significant exceptions might be cited, but I am speaking broadly.

From the state of being largely ignored as a social and economic factor, science has in my own lifetime reached the condition of credit for complete transformation of the social and economic conditions of modern life, and this arouses expectations of new discoveries that will quicken old and create new industries, that will protect us in time of war, that will improve the health of the people and its innate qualities, and that will enable governments better to discharge their almost infinitely complex responsibilities.

It is unthinkable that the National Academy of Sciences should not respond to the utmost of its capacities. Created as it was to advise the agencies of the Federal Government on any subject of "science or art," and pledged as each member is to render his services to the government without any compensation whatever, the present grave time calls for a renewed dedication to the service of our country. Our government expects and is entitled to this service from us by the very articles of incorporation.

The intention of the creators of the academy was not, however, to establish another bureau under government control—either in the minds of the government or of the founders themselves—it was, on the contrary, to establish a free and independent body, with complete control over election to membership, that could be relied upon to advise without bias or fear. For this reason the no-compensation clause, to which I have alluded, was introduced; and for this reason the academy itself has neither sought nor received financial support from the government.

Four years ago my predecessor in office, the deeply lamented William Wallace Campbell, reminded us of the similarly disinterested position of the Royal Society of London, and quoted the statement in the annual address of the president of the Royal Society in 1904, Sir William Huggins:

> . . . The Royal Society . . . asks for no endowment from the state, for it could not tolerate the control from without which follows the acceptance of public money, nor permit of that interference with its internal affairs which, as is seen in some foreign academies, is associated with state endowment.

The functions of the National Academy in relation to the government were much more fully defined in President Wilson's executive order of May 11, 1918, in which he requested the National Academy of Sciences to perpetuate the National Research Council. Every member of the academy should occasionally read this executive order, prepared with the advice of some of our members, for it is the principal outstanding historical event, so far as the academy is concerned, since its foundation. The most important extension of the charter is undoubtedly the direction to the National Research Council "to develop effective means of utilizing the scientific and technical resources of the country" for stimulation of scientific research and its applications in engineering, agriculture, medicine and industry, for strengthening of the national defense and for cooperation in the interests of the public welfare in general.

I speak of these things as functions of the academy because of my strong conviction that the academy and the council are one and indivisible. Perhaps this conviction was quickened by my unique experience of holding simultaneously, for the space of one year, both the offices of president of the academy and chairman of the National Research Council; but in the three years ensuing this conviction gained strength.

Now these responsibilities are rather overwhelming, and it is no wonder if at times, since the enthusiasm of the Great War, our footsteps may have seemed to falter. The discharge of them requires the closest cooperation between academy and council. We must be constantly watching the tide and be prepared to take it at its flood.

There is not time to enumerate many accomplishments or specific activities. These are described, if not vivified, in the grave and gray pages of reports; and the prepared, intelligent and sympathetic mind can learn much from them. Would that some of our critics had so profited!

A considerable number of important special projects and studies of the National Research Council are quite adequately supported by special funds generously provided by foundations and others. But support of the general strategy and overhead expense involved in the promotion of the scientific, industrial and social, governmental and public interests, both of the academy and the council, is woefully inadequate and quite incommensurate with the opportunities and responsibilities. The possibilities for service can not be fully realized until the free income of the academy and council is greatly increased.

I shall not dwell upon the activities of the National Research Council, in the attempts to raise the standards of the scientific personnel of the country through post-doctrate fellowships and in numerous other ways; nor on the rapidly developing relations with industrial and medical research; nor yet on the several continuing projects of stimulation of research or of aids to learning in special fields supported by various foundations; nor even on the several research organizations fostered and in some cases set up by aid of the National Research Council. I shall leave these reviews and others to the chairman of the National Research Council at the appropriate time.

But I would like to say something about the government relations of the academy and council. Here I wish to draw a distinction. On the one hand there are day-by-day relations, formal and informal, which are sustained by the chairman of the council, by the executive secretaries of the academy and the council, and as opportunity offers, by members of both, either in official or unofficial capacities. On the other hand, there are formal reports prepared at the request of government agencies by committees appointed by the president of the academy. Somewhere in between comes our relationship with the National Resources Committee of the government through its science committee, on which we have three representatives.

I do not exaggerate when I say that our success in carrying out the obligations of the charter of the academy depends upon what I have called day-by-day relations with government agencies. For it is necessary that we should know them, and that they should know us. In no other way can our relations succeed. They should know that we are here as friendly fellow-citizens with some scientific information, and that if there is occasional criticism on our part it is that of friends with a double stake in the problems with which they deal. They should also know that we are in a position to aid them in utilizing the scientific resources of the country. In this process of growth of mutual understanding we rely especially on those members of the academy and of the council who are also in the direct service of the government.

The rendering of formal reports is occasional. Into these reports should always go the best opinion of the academy. They should be judicial and authoritative. It is such reports that the Congress and the founders of the academy had in mind when framing the act of incorporation. The academy must therefore decline to attempt reports in fields in which it is not fully competent.

In the organization of the academy and council, the Government Relations and Science Advisory Committee, of which the president of the academy is chairman *ex officio*, has special oversight of such reports, which are prepared by subcommittees appointed by the chairman. Such subcommittees are appointed on formal request by the appropriate officers of the government, and the agency concerned provides by contract for payment of out-of-pocket expenses of members of the subcommittees and for any necessary expenses of investigation; but the members of the subcommittees receive no compensation whatever for their services.

At the present time six such subcommittees are in operation, two of these being retained as advisory committees to the agencies in question. Three other advisory committees, not concerned in the preparation of formal reports, have also been appointed as subcommittees of the Government Relations and Science Advisory Committee. It is perhaps needless to say that the proceedings of such committees are held confidential, by the academy, but may be released by the government.

The National Resources Committee, engaged in the preparation of plans for the long-time utilization of national resources, reports its findings to the President and the Congress with recommendations. Such planning involves land, water, public works, industry, energy sources and population. In each of these divisions scientific considerations are of primary importance. A little more than four years ago, the chairman of this committee, the Honorable Harold L. Ickes, requested the president of the academy to appoint three of its members to a science committee of the National Resources Committee, which includes also three members representing the social sciences and three representing education. This was accordingly done, and the academy has been so represented ever since. The work of this committee has been of growing importance, and our own relations to the government have profited increasingly through it. The academy and the council highly value this new avenue of relations with government agencies.

Frank R. Lillie

ABSTRACTS OF PAPERS

Ultra-violet solar intensities and ozone distribution in the upper atmosphere: W. W. Coblentz and R. Stair. In a preliminary report (Science, 87: 426, 1938) a summary was given of the progress made in measuring the ultra-violet solar intensity and thereby determining the vertical distribution of atmospheric ozone at various heights above the earth's surface, by means of a photoelectric ultra-violet intensity meter and auxiliary radio-transmitting apparatus, transported aloft by means of unmanned balloons. As a matter of record the following report is given of the results obtained, during the summer of 1938, with the aid of a grant from the Joseph Henry Fund, in cooperation with the National Bureau of Standards. Two kinds of measurements were obtained: (a) the spectral quality and total intensity of ultra-violet solar radiation, at a fixed ground station, at Flagstaff, Arizona (elevation 2.2 km), and (b) similar measurements at various elevations above the earth's surface, at Washington, D. C. In the ultra-violet measurements at Flagstaff, a close parallelism was observed in the variation in the percentage transmission of the filters with variation in barometric pressure; in agreement with the well-known variation in the amount of atmospheric ozone that accompanies a change in air pressure. On one occasion the wave of low barometric pressure preceded, by 5 to 6 hours, an appreciable increase in atmospheric ozone; indicating a method of studying the circulation of ozone in the stratosphere. In four balloon ascensions, made in Washington, D. C., in June, 1938, the photoelectric ultra-violet intensity meter attained heights ranging from 25 to 27 km; penetrating 60 to 70 per cent. of the atmospheric ozone, the most of which was localized in a layer extending from an elevation of 18 to 27 km, with a wide maximum of concentration at a height of about 25 km above sea level. At the highest elevation attained by the instruments the intensity of the ultra-violet of short-wave lengths was about ten times that of direct sunlight at sea level.

A new method of determining individual line-of-sight velocities of star groups: R. W. Wood. Two prisms of 6° angle are mounted one above the other with refracting edges pointed in opposite directions. Each is covered with a replica grating of 4,800 lines to the inch, giving 85 per cent. of the light in the first order spectrum, the combination giving direct vision for the violet region. One grating is inverted with respect to the other, the combination giving two parallel spectra of each star, in coincidence in the violet and ultra-violet regions, the red ends lying in opposite directions. Line of sight velocity causes the spectra to shift in the direction of their length and in opposite directions. Excellent spectra have been obtained of bright stars with a lens of 3 inches aperture and 16 inches focus at the observatory of Mr. Joseph Woods, of Baltimore.

Cosmic ray intensity and the thermal expansion of the atmosphere: A. H. Compton, M. Schein and P. S. Gill. The temperature coefficient of the intensity of cosmic rays found by one of us in the data obtained in the northern and southern hemispheres of the Pacific Ocean has recently found a suggested explanation by Blackett. This is based upon Yukawa's hypothesis that the mesotrons which constitute these cosmic rays are produced in the upper atmosphere by less penetrating radiation and that they show spontaneous disintegration similar to radioactivity. When the atmosphere expands at the higher temperature, the elevation at which the mesotron is produced is greater and there is a higher probability of spontaneous disintegration resulting in a lower intensity at sea level. Using for the mean life of the mesotron when at rest $\tau_0 = 2.7 \times 10^{-6}$ sec., Blackett thus calculated a temperature coefficient agreeing closely with that observed by us. He predicted, likewise, that near the equator, where the average energy of the mesotron is greater, the temperature coefficient should be smaller. Using extensive additional data from the Pacific Ocean, we have experimentally confirmed Blackett's predictions of a smaller temperature coefficient in equatorial regions. We have calculated from our data the altitude at which the mesotrons are created in the earth's atmosphere and find that this is a maximum of about 25 kilometers at a latitude of about 38°. This corresponds to the knee in the latitude effect curve. The variation in the altitude at which the mesotrons are produced gives a significant indication regarding their method of production.

Seasonal effects in cosmic ray intensities from sea level up to the top of the atmosphere: Robert A. Millikan and H. Victor Neher. By sending our self-recording electroscopes on successive trips from Los Angeles to Vancouver and back, and then around South America and back to Los Angeles, we have checked in these areas the result first recorded by Steinke and very carefully studied later by Messerschmidt, Hess, and Compton and Turner that there is a definite seasonal sea-level variation in cosmic-ray intensities. Like the last observers, we find no seasonal effect in the equatorial belt, but in the higher temperate zones the sea-level intensities are definitely higher by from two to four per cent. in winter than in summer. Furthermore, recent flights which we have made at Omaha up to close to the top of the atmosphere reveal similar but considerably larger intensity differences between winter and summer, the winter readings being consistently higher. These Omaha results seem to be scarcely explicable in terms of the theory advanced by Blackett.

Further confirmation of the Coster-Kronig theory of the production of doubly-ionised atoms: F. K. Richtmyer and Ross E. Shrader. At the Rochester (1937) meeting of the academy we reported measurements on the satellites of the x-ray line $L\alpha$ in the atomic number range $73 < Z < 92$, which qualitatively confirmed the theory proposed by Coster and Kronig (*Physica*, 2: 13, 1935), that the initial state for the production of these lines is a doubly ionized state, $L_{III} + M_{IV,V}$, arising from an internal absorption of energy known as the Auger effect. The energy required to expel an M_{IV} electron from an atom is sufficiently higher than that required to expel an M_V electron so that, while satellites due to $(L_{III} + M_V)$ ionization should appear above Ta 73, satellites due to $(L_{III} + M_{IV})$ ionization should not appear until Ir 77 is reached. We now report more accurate data for the intensities of $L\alpha$ satellites in the range $73 < Z < 92$ obtained by a high-resolving-power two-crystal spectrometer. The curve of intensity vs. Z shows two branches, one beginning at Ta 73 and the other at Ir 77, in excellent agreement with the Coster-Kronig theory.

The number of lines in a series as a function of electron pressure: Fred L. Mohler (introduced by W. W. Coblentz). In an intense discharge the higher series lines merge into a continuous spectrum at an effective quantum number which depends on the electron pressure. Studies of the cesium discharge covering a wide range of vapor pressure and current density give a basis for determining this relation. The maximum quantum number in a series is found by plotting the relative intensity of line to background versus quantum number and extrapolating to a ratio of unity. The relation between electron pressure and the maximum quantum number for both the red component of the D series and the F series is P_e (atmospheres) $= 4.5Tn^{-7}$. Computations by Pannekoek for the Balmer series indicate that this relation is equally applicable to hydrogen. The number of absorption lines in the Balmer and Paschen series of some stars has been determined by the same criterion used for cesium. For main sequence Ao stars the electron pressure at the photosphere is about 0.4×10^{-4} Atm. at the Balmer limit, 0.8×10^{-4} at the Paschen limit and 2×10^{-4} Atm. at 4340A. Alpha Cygni has an electron pressure of about 2×10^{-6} Atm. at the Balmer limit, while for white dwarfs the pressure is roughly 10^{-2} Atm.

The Hall effect and change of resistance in a magnetic field: W. V. HOUSTON and L. DAVIS (introduced by R. A. Millikan). The normal Hall effect can be directly interpreted in terms of almost free electrons, although the positive Hall effect requires for its explanation electrons whose binding to the nuclear lattice is of considerable importance. On the other hand, the change of resistance in a magnetic field can be interpreted only on the assumption that the nuclear binding causes essential departures from the behavior of free electrons. These facts can be easily illustrated in a qualitative way. Since a change of resistance is observed in the alkalis, it is of interest to see if this can be understood quantitatively as a small departure from a free electron situation. The electron energy as a function of wave number, as well as the relaxation time, can be expanded in a series of spherical harmonics that have the symmetry of a cubic crystal. This permits the necessary integrals to be carried out to any desired degree of approximation. When only the first two harmonics are retained, the computed change of resistance and Hall effect are close to the observed values. However, the ratio of the transverse to the longitudinal change of resistance can not have a value less than four. This is not in agreement with the available observations. It seems improbable that this result could be changed in any major way by the inclusion of higher series members, so that if the experimental results are to be taken as reliable, doubt is thrown upon the basic method of interpretation of the effects.

The cause of intense color in the carotenoid pigments. ROBERT S. MULLIKEN. As is well known, the carotenoid pigments, which are responsible for the color of various vegetable and animal substances (*e.g.*, carrots) have a conjugated polyene structure. That is, each molecule contains a long chain of alternately single and double carbon-carbon bonds. A theoretical explanation of the existence of visible absorption, hence of color, for such molecules is implicit in quantum-mechanical calculations of Hückel, although Hückel did not himself discuss the spectra. In the present work, quantum-mechanical calculations of the intensities of various spectral absorption regions are made, and it is shown thereby theoretically that the longest wave-length absorption region should be by far the strongest, with very high intensity indeed. This is in agreement with experimental observations. Thus the exceedingly strong visible absorption of the carotenoids, giving intense color, is explained. According to the theory, the shape of the molecule should strongly affect the distribution of intensity in its spectrum. The more elongated the molecule, the more the intensity should be confined to the long wave-length end of the spectrum, and the more intense should be the color. Available experimental evidence on substituted polyenes supports the theoretical predictions if it is supposed that polyene chains normally assume the most elongated possible form. When part of the polyene chain is bent into a ring, the intensity is reduced. According to the present calculations, the intense long wave-length absorption regions in elongated carotenoid molecules correspond to light polarized approximately along the long axis of the molecule. This should give rise to a high polarizability of such molecules along that direction, and this may help to explain their reactivity.

The "liquid structure" of water; with special reference to ionic solutions: G. W. STEWART. The recognition of the manner in which water as a solvent may alter its density is recent. Experimental evidence from an x-ray study of the aqueous solution of fifteen electrolytes is now adduced to show that the ions in solution have a more significant effect than is explicable on an electrostatic basis. This is the alteration in liquid structure of the water through the increase in coordination number. This change in number occurs similarly with increase in temperature of pure water. The variation with concentration of the structure, as indicated by x-rays, has a striking correspondence with the variation of the apparent molal ionic volume. The ions were both simple and complex with six of the electrolytes of a 1–1 type, six of them 2–1, two of 3–1 and one of a 1–2. The effect of the increase in coordination number of the water is to give closer packing and greater density.

The automatic synthesis of speech: HOMER DUDLEY (introduced by O. E. Buckley). Synthetic speech has been formed with an electrical circuit by the modulation of a buzzer-like tone for the voiced sounds and a hiss for the unvoiced sounds. The tone consists of a fundamental vibration and its harmonics; the hiss, of purely random vibrations. The modulation processes are of two types: one, a pitch variation for inflection in the synthetic voiced sounds and the other, amplitude variations of the component vibrations in both the voiced and unvoiced sounds. In the automatic synthesis of speech the two basic sounds are modulated by speech-defining electrical currents, varying at syllabic rates, which are obtained by a substantially instantaneous analysis of a talker's speech. The artificial speech is not only intelligible but reproduces in good measure the inflection and timbre of the original. The simplicity of these speech-defining currents points to such future possibilities as aural speech studies by their controlled modification and reduction in frequency band required for telephonic transmission. The procedure and results will be illustrated from phonograph records.

Breakdown in impregnated paper insulation: J. B. WHITEHEAD. In accordance with current theories of the nature of breakdown in solids, it has been assumed that an increase in the density of the impregnated paper used for cable insulation results in a higher dielectric strength. Following this assumption, manufacturers have used high density papers for a redistribution of normal stresses within the insulation and also for the purpose of increasing dielectric strength. In the present tests four grades of paper of different values of density, but all from the same wood pulp stock and all the same thickness, have been studied in accelerated life tests. In these the voltage was raised with a gradual logarithmic increase, with measurements of various electrical quantities at intervals up to final breakdown. The average duration of the test was about four days. The results show that with increasing specific gravity of the paper, the dielectric strength of the impregnated sample, instead of increasing with increasing density, shows, in fact, a noticeable decrease. Within the range of specific gravity of the paper 0.74 to 1.18, the decrease in breakdown voltage is 30.5 per cent. and the decrease in life is 47 per cent. An explanation of the above result has been found in the use of a device for limiting the current and consequent burning of the breakdown process, and for locating the point at which breakdown begins. The device consists of a thyratron tube controlled by the current from the specimen, and which in turn operates a rapid circuit breaker. Careful examination and dissection of the specimens reveals that breakdown almost invariably begins in the narrow channels between two successive spirals of the paper tapes, these channels being filled with oil. Corresponding measurements of dielectric constant of the oil, of the paper and of the impregnated paper permit computation of the stresses in these oil channels. It was found that these stresses had approximately the same value for all four grades of paper. Thus the decreasing dielectric strength with increasing paper density is caused by the increased dielectric constant of the impregnated paper, as this increase shifts a greater proportion of the total stress to the oil in the oil channels. The values of the stress in the oil channels immediately preceding failure were in the range 1,300 to 1,500 volts per mil. Apparently in this neighborhood ionic motion in the oil becomes so rapid as to cause secondary ionization, increased conductivity, gas liberation and ultimate gaseous ionization, with resulting chemical or thermal attack of the paper structure causing rapid penetration of the latter and leading to complete breakdown.

The neurohumoral activation of vertebrate chromatophores: G. H. **PARKER**. Two decades ago all vertebrate color-cells would have been said to be under the control of the nervous system. Since that time intermedin, the neurohumor of the intermediate lobe of the pituitary complex, has been shown to be the chief agent in causing darkening in these animals. Only a few teleost fishes appear to be exceptions to this rule, which holds in general for most fishes, and all amphibians and reptiles thus far tested. Darkening is also accomplished in certain teleosts by dispersing nerves. The blanching of chromatic vertebrates is due chiefly either to a loss of intermedin, to the action of such a concentrating neurohumor as adrenalin or to concentrating nerves. From the modern standpoint the blood-soluble hormones intermedin, adrenalin and other like substances far outrun nerves in their control of chromatophores. They appear to be the exclusive agents in the cyclostomes, most elasmobranchs, all amphibians and such lizards as Anolis. Obvious nerve control appears only in a very few elasmobranchs, a number of teleosts and such lizards as the chameleon and the horned toad. Where nervous control has been studied, chiefly among fishes, it is believed both in its concentrating and its dispersing phases to depend upon oil-soluble neurohumors, the lipohumors, from the nerve terminals. Thus the activation of vertebrate chromatophores appears to result in the main from blood-soluble hydrohumors, chiefly intermedin and adrenalin, supplemented by several lipohumors from direct nervous sources. It is remarkable that in these responses acetylcholin appears to play little or no part.

Changes of viscosity and cell activity: **WARREN H. LEWIS**. Changes of viscosity of protoplasm, sol to gel, gel to sol and intermediate states, play important roles in cell activity. Gelated colloids *in vitro* automatically exert contractile tension and presumably gelated protoplasm acts likewise. The assumption that active cells possess a superficial layer of gelated cytoplasm, the plasmagel layer, which exerts contractile tension offers a key for an explanation of various cell activities. A uniform tension would tend to make cells spherical, local variations of it would produce distortions and thrust out cell processes and pseudopodia. It plays the leading role in locomotion of cells. An early indication that a cell is about to divide is the retraction or partial retraction of its processes and pseudopodia. This is probably due to an increase in the viscosity of the superficial plasmagel layer of the processes which automatically increases their contractile tension. The cell then tends to become spherical, due to the development of a more uniform viscosity of the superficial plasmagel layer over the body of the cell. The cleavage of cells in mitosis is to be explained by the development during anaphase of a thickened or denser equatorial band of the plasmagel layer which automatically flattens and then constricts the cell because of the increased contractile tension developed. Deeper within the cell changes of viscosity play equally important roles. When the chromosomes are in the equatorial metaphase plate motion pictures reveal that individual chromosomes oscillate independently of one another in paths between the poles of the spindle. This suggests (1) that in the living cell there are, after all, invisible spindle fibers which extend from each chromosome to the poles of the spindle; (2) that the fibers are gels and hence exert contractile tension on the chromosomes; (3) that the two fibers of each chromosome undergo somewhat irregular alternate changes in viscosity with corresponding changes in contractile tension; and (4) that the oscillation of each chromosome is thus due to this alternation of pull on it, first toward one and then toward the other pole of the spindle. When the chromosomes are pulled or split apart oscillation ceases and each half moves or is pulled steadily toward its respective pole by the contraction of its spindle fiber.

The time factor in x-ray irradiation: **KARL SAX** (introduced by I. W. Bailey and E. D. Merrill). Most of the experiments on the effect of x-ray intensity show that concentrated doses are more effective in killing cells than the same dose given slowly. Similar results have been obtained for chromosome aberrations in Tradescantia. Both intermittent raying and continuous raying at various intensities show the effect of the time factor. In one experiment with a total dosage of 320 r, given at various intensities from 20 to 320 r/m, the relation between the percentage of chromosome breaks and radiation intensity is expressed by the equation, $\log B = 0.314 \log I + 0.764$. Previous experiments on the nature of x-ray-induced chromosome aberrations provide an explanation of the effect of the time factor. Most of the aberrations induced in the resting nucleus are dependent upon two independent x-ray hits. If the radiation is given slowly a break in one chromosome may heal before another break occurs in an adjacent chromosome. The second break also heals and no visible aberrations appear at metaphase. When the radiation is intense two adjacent breaks may occur within the critical time period, so that fusions can take place between broken ends of different chromosomes and produce dicentric chromosomes. In cells irradiated at prophase both 1-hit and 2-hit breaks occur with a rather high frequency, but only the 2-hit breaks are affected by the time factor. Broken ends of chromosomes may remain in an unstable condition and retain their capacity of fusion for about one hour. The duration of the nuclear cycle in the Tradescantia microspores is about one week. This interpretation of the time factor in irradiation may have some application to x-ray treatment of cancer. Intermittent radiation of low intensity should produce sufficient breaks in prophase nuclei to prevent normal cell division, but with little injury to the less active cells of normal tissue.

A new dominant lethal, E, in Neurospora tetrasperma: B. O. DODGE. Ascospores from a culture of *N. tetrasperma,* race substriata from Texas, which had been kept dry for five years germinated fairly well following heat treatment. Their mycelia gave rise to normal ascocarps with 4-spored asci except in one case, where a large percentage of the asci aborted without spore formation, but with no induration of the ascus wall. In some ascocarps no asci with spores were present. As a rule when asci did mature spores there were usually eight and not four spores as should have been expected. All ascospores from an 8-spored ascus that germinated and developed mycelia were normal, since ascocarps formed when two of opposite sex were mated gave 4-spored asci, never 8-spored asci. Occasionally, an ascus delimits seven spores, one being larger and bisexual and one of its nuclei being normal, while the other nucleus, which is usually of opposite sex, carries a new dominant lethal factor, E. A mycelium from such a spore bears ascocarps, the asci of which, with few exceptions, all abort. Such a lethal factor must be dominant because every ascus, of which there are over a hundred in each fruiting body, is heterozygous for the lethal. This new dominant lethal, E, differs from the lethal, I, previously described, in that no induration follows ascus abortion, and asci that do develop spores are usually 8-spored and not 4-spored. In both cases these lethal factors can only be carried along in a cell having another nucleus which is normal or non-lethal.

The nature of x-ray-induced lethal changes in the Notch region of the X-chromosome of Drosophila melanogaster: M. DEMEREC (introduced by A. F. Blakeslee). Cytogenetic study is completed for 36 lethal changes induced by x-rays in the white-Notch region of the X-chromosome. Numerous types of the same region showing mottling, as well as numerous viable changes will not be considered here. X-rays of about 0.72A° and dosage of 2,500 to 3,000 r-units were used in these experiments. Of 36 changes, 7 are connected with either inversions or translocations, 26 are deficiencies showing in salivary gland chromosomes a section of from 1 to 46 bands missing, while three cases had no such cytologically detectable deficiency. A deficiency may be induced either by the occurrence of two breaks, the piece between the breaks being lost or by the elimination of a piece through a chemical change. A study of 1,038 induced breaks made by Bauer, Demerec and Kaufmann shows that they are distributed at random and that they occur independently. Thus, if two independent breaks are responsible for a deficiency, it is to be expected that deficiencies of various lengths will occur with an approximately equal frequency. That holds true for deficiencies involving 5 to 46 bands, but small, 1–4 band deficiencies are much more frequent than expected (12 from 27 cases). This indicates that large deficiencies and part of the small ones are probably induced by two independent events, while the majority of small deficiencies are induced by one event, either an extensive chemical change or two interdependent breaks. The majority of changes involving inversions or translocations showed no cytologically detectable deficiency (6 from 7), indicating the effect of the position on the action of a gene. Salivary chromosome bands, as shown on Bridges' 1938 map, were correlated with genetic loci through overlapping deficiencies as follows: white 3C1, roughest 3C4, facet 3C7 and diminutive 3D1.2 doublet.

Rhythmical impulses in the heart and in a plant cell (Nitella): W. J. V. OSTERHOUT and S. E. HILL. In the heart rhythmical electrical impulses originate in a pacemaker and pass from the auricle to the ventricle. Under certain conditions the rhythm in the auricle becomes too rapid for the ventricle to follow, so that only every second or third impulse passes over. This is known as partial block: complete block also occurs and the ventricle then takes up a rhythm of its own. Various irregular rhythms are encountered, including electrical alternans (every other impulse stronger) and premature beats followed by an extra long pause (as in extra systole). Experiments have been made by creating a pacemaker at one end of a *Nitella* cell by applying a drop of potassium chloride. When the electrical rhythm is made rapid by previously treating the cell with sodium chloride we observe many of the irregularities found in the heart. The irregularities found in the heart have sometimes been regarded as arising in the bundle of His by which the impulses pass from the auricle to the ventricle. Such an explanation can not apply to *Nitella,* in which the conducting medium is undifferentiated protoplasm. Apparently, all conducting systems have certain fundamental factors in common, which make such irregularities possible.

Induction of periclinal chimeras in Datura stramonium by colchicine treatment: A. F. BLAKESLEE, A. D. BERGNER, S. SATINA and E. W. SINNOTT. It has been earlier reported that colchicine by its action on dividing nuclei may induce a doubling of the number of chromosomes in the individual cells affected. When 2*n* seeds of *Datura stramonium* are treated, a mixture of 2*n* and 4*n* tissue results from which pure 2*n* and 4*n* branches as well as branches which lack one or more chromosomes may arise. It is now possible to report from seed treatment of Daturas the occurrence of periclinal chimeras in which the cells of the inner portions of the branch have the normal number of chromosomes, while the cells of the outer tissue contain the doubled number. The occurrence of these periclinal chimeras has been established by several lines of evidence. In many cases the appearance of a given branch disagreed with the chromosome number of the generative layer estimated by size of pollen grains or determined by actual chromosome counts in pollen-mother cells. Guard cells of the epidermis and their nuclei in some cases were of the 4*n* size, while the pollen mother cells were 2*n*. Cross sections of flower stalks in such cases showed the epidermis cells enlarged like those in 4*n* plants but the inner cells of the size characteristic of such 2*n* tissue. The size relations of cells have been checked by chromosome counts. In periclinal chimeras in which the epidermis is 4*n* and the inner tissue 2*n*, it is possible to identify cells of epidermal origin by their chromosome number. It is thus possible to show that part of the internal tissue of calyx, corolla, stamens and pistil are derived from the epidermal layer and that the chromosomal constitution of the epidermis is of major importance in determining the shape of the mature capsule.

The chemical induction of genetic changes in fungi: CHARLES THOM and ROBERT A. STEINBERG. The monographer of molds finds groups of strains differing in colony aspect to a degree commonly accepted as specific but producing spores with essential characters in common. Discrimination between variation, mutation and specific identity is difficult. The possibility of increasing the numbers of variants among fungi upon definite lines, by stimulating substances seemed worth considering. The molds selected were strains of *Aspergillus niger*, *A. amstelodami* and *Penicillium caseicolum* which had grown in the laboratory more than 20 years without noteworthy variation. Neither colchicine nor acenaphthene produced inheritable variations. A large number (154) of dyes, phenanthrene derivatives and miscellaneous organic compounds led only to sporadic variants with the *Aspergilli*, none with *Penicillium*. Growth in a nutrient salts solution containing carbon as 5 per cent. mannitol, nitrogen as 0.2 per cent. sodium nitrite and adjusted to pH 4.0, gave almost invariable response with the *Aspergilli*. Changes in dilutions were occasionally required. *Aspergillus niger* has formed thus far about a dozen variants which persist in culture and tend to reappear in successive trials. *Aspergillus amstelodami* produced a variant differing greatly in colony character, with ascospore production greatly delayed and almost suppressed. The variants show suppression of characters, production of sterile mycelia, reduction of accessory spore-producing mechanisms such as stalk, and vesicle of Aspergillus to vestigial, and spore production reduced to small clusters of spore-producing cells with short chains of conidia. Spores when produced retain the sizes and markings characteristic of the species. Similar variants are already known among the black Aspergilli. A similar series in *A. sydowi* have been collected in nature. Hypothetically the process involved may be due to the effects of nitrous acid on amino nitrogen, suggesting the possibility that other natural aberrant forms may also be associated in some instances with excess nitrite.

Cellular relationships during growth and differentiation in plant growing-points: EDMUND W. SINNOTT. By means of a technique previously described it is possible to study the multiplication, enlargement and differentiation of living cells in the apical meristems of certain roots. Changes in a given cell are found to be closely related to those in the cells which surround it. In rapidly growing roots, when a cell divides, the new transverse wall tends to be laid down in a position as far as possible from contact with the transverse walls of neighboring cells. In most slowly growing roots, where the longitudinal walls have become firmer, this relationship is less pronounced. A study of expanding cells indicates that the cells do not slide along one another, but that the wall of one cell is firmly attached to those of its neighbors. Different portions of a cell wall, however, may expand at different rates during the process of development, so that the relative sizes of cells become altered; but the growth of any portion of a cell wall is the same as that of the adjacent wall of its neighboring cell. This process of differential wall growth is an important aspect of cellular differentiation.

The active uptake of ions by organisms: AUGUST KROGH. It is well known that the ionic composition of the protoplasm in animal cells differs significantly from that of the surrounding fluid, and in the case of a few eggs there is evidence to show that ions are absorbed from very dilute solutions. In the large plant cells, studied by Osterhout, Collander and others, active absorption of ions into the cell sap has been observed and mechanisms for such absorption suggested. In plant roots Lundegårdh has demonstrated an active transport of anions from very dilute external solutions into the much more concentrated sap rising in the stem. In a number of fresh-water animals we have observed more or less specialized mechanisms which take up certain ions from the outside solution and concentrate them say from millimolar or less to 100 millimoles in the blood. We find separate mechanisms for kations and anions, respectively. In certain Crustacea the kation mechanism will take up Na and K indiscriminately, leaving out Ca, but in most animals studied the mechanism is strictly specific for Na only. The anion mechanism has been found in a single case not to discriminate between Cl, Br, CNS and CNO, but in all other cases it is specific for Cl and Br, which can not be distinguished, either, by the kidney mechanism of man. It is suggested that all these mechanisms are nearly related, but that the more specialized are more likely to furnish clues as to the modus operandi.

The ontogeny, nature and mode of activation of the intracellular enzyme, tyrosinase: JOSEPH HALL BODINE (introduced by Carl E. Seashore). By means of manometric methods the growth of the enzyme tyrosinase has been followed throughout the entire development of the embryo of the grasshopper. Evidence has been obtained indicating the auto-catalytic nature of this growth. The enzyme as produced is in an inactive state and can be activated by a normally occurring intracellular activator as well as by various chemical and physical reagents such as sodium oleate, acetone, ether, chloroform, heat, etc. The kinetics of the activator have been studied in some detail. The parts played by the denaturation and active center formation in protein are discussed; a probable correlation between these and the activation of the enzyme is pointed out.

Evidence for the existence of an electro-dynamic field in living organisms: H. S. BURR (introduced by Walter R. Miles). The existence of electrical activity in living things is attested by electrocardiographs and electroencephalographs. Recently, it has been possible to add to these graphs of steady state voltage differences which possess definitive patterns characteristic of the species to which the animal belongs and, in all probability, of the individual itself. This pattern has been shown to change with alterations in the fundamental activity of the organism. In the growing embryo the electrical pattern develops hand in hand with the development of the whole organism. A definite cycle of electrical phenomena correlates with the menstrual cycle in women. Under proper conditions it has been possible to record electrically the exact instant of ovulation in rabbits, cats and women. The progress of healing in wounds shows electrical concomitants which parallel very closely the reparative process. In mice it has been possible to detect adenocarcinoma of the mammary gland by characteristic changes in the overall electrical pattern of the organism a week or more before it can be detected by palpation. The results of many hundreds of thousands of determinations indicate that relatively steady state voltage differences are an expression in quantitative terms of one form of the relationships which exist between the units of the organism. This suggests that the simplest assumption with which to explain all the evidence so far gathered is that of the existence in the living organism of an electro-dynamic field.

The steady potential of the human eye in subjects with unilateral enucleation: WALTER R. MILES. The electrical potential derived from the human eyeball may be measured with a sensitive galvanometer connected with small metal foil electrodes on the skin near the eye. Measurements may be made with subjects reclining in a chair or sitting upright at a headrest. The method of making such examinations, and their reliability, has recently been described. The present study deals with an analysis of data secured on a group of subjects who have suffered unilateral enucleation, and in consequence have to wear one artificial eye. The steady potentials found in 9 such cases are compared with the steady potentials found for normal subjects who each have two living eyes. The relationships previously described, Ld. 1 plus Ld. 2 = Ld. 3 plus Ld. 4 can not hold in cases of unilateral enucleation. In the normal eye it is found that the potential is larger after abductive movements than after adductive movements. The difference is usually about 8 per cent. The same relationship is found to hold for the enucleation group. The bitemporal lead in the normal group gives a potential value that is one third larger than the mean of the two eyes measured separately. In the enucleation group this is essentially reversed, the single active eye providing a potential that is one third larger than that found for the bitemporal lead. The enucleation group provides a special opportunity to analyze the potential-field relationships associated with and surrounding a single active eye. Lantern slides will be used.

The span of visual discrimination as a function of duration and intensity of stimulation: W. S. HUNTER. A study of the span of visual discrimination as dependent upon the duration and intensity of stimulation affords an opportunity to relate what has been known as the span of "attention" to known facts of light stimulation. The Bunsen-Roscoe Law, I · t equals a Constant, has been shown to hold within limits for a variety of biological processes ranging from the heliotropic curvatures of seedlings to visual acuity in man. In the present experiments, which are the first systematic study of the effects of time and intensity on the span of discrimination, the law has again been found to hold within certain limits. In the present work light of controlled intensity and duration was transmitted through stimulus plates containing various numbers of black dots on translucent white paper, the entire stimulus falling within the fovea of the subject. The absolute intensities ranged from 0.016–13.3 millilamberts; the durations of stimulation, from 0.004–1.0 sec. The subject's response indicated the number of dots seen at each presentation. For each time and intensity, limens were determined showing the number of dots seen correctly 50 per cent. of the time. When these limens are plotted against log I, there results a family of curves for the different durations showing decreases in the required intensities with increases in time. The maximal limen for durations of 0.004, 0.008, 0.016, 0.032 and 0.075 secs. was 8 dots, although the intensities at which the limen was reached varied with the different durations. For 0.150 secs., the maximal limen was 9 dots; for 0.30 secs., 10 dots; for 0.60 secs., 12 dots; and for 1.0 secs., 14 dots. A graph of log I · t against log T for the discrimination of 1, 2 or 3, and up to 6 dots indicates that I · t is constant for durations from 4 to 32 ms., after which the intensity required does not decrease proportionately as time increases.

The function of the mute on the violin: CARL E. SEASHORE, ARNOLD SMALL and E. P. HORNE. What is the effect of the mute on the total intensity and the harmonic structure of the tone? This paper is a unit in a series of experimental studies on the acoustic characteristics of the violin. Tones were recorded from good violins, played mechanically in a dead room and submitted to harmonic analysis. The effect of shape, weight, material and seating of the mute was studied on each of the four open strings. It was found that the chief variable in a mute is its weight. The effect of size, material and seating were relatively insignificant; although different for the different strings. The mute tends to reduce the total intensity of the tone, not in the fundamental but in the other partials at various levels. The change of harmonic structure varies with the string, the pitch level, the character of the violin, the character of the mute and other factors. Results are shown in graphs.

History in the archives of the Royal Society: SIR WILLIAM BRAGG. The large store of papers in the possession of the Royal Society provides material for history from many different points of view. In particular, it shows how the simple experimental science of its founders, with their common interest in all that came under their notice, has gradually become the highly developed science of to-day, each section of which is intelligible only to its specialist. At the same time, the study of natural knowledge has become of great importance in all branches of human activity. The effects of these changes upon the relations between science and the human society are obvious and very important. They are in consequence receiving serious consideration. For this purpose it is of interest to compare the position of experimental science at different times since the Royal Society was founded: and the society's archives furnish convenient illustrations.

Higher element transformations: EDWARD KASNER. The concept of differential element is important in differential equations and physics. The simplest type in the plane is a point with a direction represented by (x, y, y'). The next type, here studied, is curvature element (x, y, y', y''). A set of ∞^1 elements is called a *series*, ∞^2 elements a *field*, ∞^3 elements an *opulence*, and the totality of ∞^4 elements a *plenum*. The transformation problem of unions is known, the new problem relates to integrable fields (see *Proceedings* of the National Academy, February, 1939). The corresponding problem of surface elements in space (x, y, z, p, q) relates to integrable fields and is more difficult (see *Duke Journal*, March, 1939). A new problem in space relates to sets of ∞^1 surface elements. When will surface strips go into strips? Finally, we study lineal elements in space (x, y, z, y', z'). If we consider merely ∞^1 elements, we obtain the classic theorem of Lie. However, when ∞^2 elements are considered, a new theory is obtained.

(To be concluded)

OBITUARY

HERBERT HENRY WOOLLARD

THE sudden death, on January 18, of Herbert Henry Woollard, professor of anatomy in University College, University of London, is a great blow to British anatomy and to his many friends throughout the world.

Woollard was born in Australia on August 4, 1889. He attended the University of Melbourne, graduating in medicine in 1910. With the coming of the Great War he joined the Australian Army Medical Corps, serving in both Gallipoli and Flanders and attaining the rank of lieutenant-colonel, with three decorations for gallantry. Following the war, he went to University College, London, to work for the fellowship of the Royal College of Surgeons. Here, largely through his contact with Professor Grafton Elliot Smith, Woollard's interests soon shifted to the field of anatomy and he became a member of the anatomy staff of University College, serving as assistant professor from 1923 to 1927. During this period he spent a year in the United States as a Rockefeller fellow, an experience that exerted a profound influence upon his later work. The friendships formed in America forged a strong link between British and American anatomy. In 1927, he was appointed to the chair of anatomy and histology at the University of Adelaide, returning to London in 1929 as professor of anatomy at St. Bartholomew's Hospital Medical School. Finally, in 1936, he succeeded Sir Grafton Elliot Smith in the chair of anatomy at University College, a post of utmost distinction. He was elected fellow of the Royal Society in 1938.

Woollard's interests covered an extremely broad scope. In his earlier years he chiefly devoted his attention to morphological problems, publishing, for example, a monograph on *Tarsius*—an outstanding contribution to primate anatomy—and a number of papers dealing with the visual pathways of primates. Much of his later work was of an experimental nature. It produced among others a series of publications on the innervation of the heart, blood-vessels and skin, which constitute his major contributions to anatomical science. At the time of his death he was concerned with other problems of cutaneous innervation and with the nervous system of coelenterates.

He was a man capable of inspiring deep devotion. Those who were privileged to work with him are particularly able to appreciate his sterling character—his uncompromising and outspoken honesty; his willingness to give unstintingly without thought of return, especially to younger workers; and his intense loyalty and devotion to his friends.

The death of Woollard at the early age of 49 years is an inestimable blow to British anatomy, for he was equally at home in microscopic and gross anatomy and, what is less common among morphologists, he knew how to utilize experimental methods for determining the functional significance of the structures with which he was dealing. The success with which he already had applied these methods to some of the most important of anatomical problems gave much promise for the years ahead. His death therefore is all the greater loss.

WILLIAM L. STRAUS, JR.

THE JOHNS HOPKINS MEDICAL SCHOOL

RECENT DEATHS

DR. EDWARD ANGUS BURT, formerly mycologist of the Missouri Botanical Garden, who has been living in retirement at his early home near Middle Grove, N. Y., since impairment of his eyesight, died on April 26 at the age of eighty years.

DR. ARTHUR P. JACOT, associate conservationist at the Northeastern Forest Experiment Station, U. S. Forest Service, New Haven, Conn., an authority on the fauna of forest soils, died on March 24 at the age of forty-nine years.

DOUGLAS D. H. MARCH, curator of the Old Panama Zoological Garden, died of a snake bite on April 3 at the age of fifty-two years.

IVAN GUBKIN, explorer and vice-president of the Russian Academy of Sciences, died on April 21 at the age of sixty-eight years.

DR. PAUL EUGENE LINEBACK, professor of microanatomy at Emory University, died on February 8 at the age of fifty-eight years.

PROFESSOR JAMES WILLIAM EDINGTON, professor of bacteriology and director of the Public Health Bacteriological Laboratory of the University of Sheffield, England, died on April 8 from injuries received in an automobile accident. He was fifty-four years of age.

DR. ERNEST H. HANKIN, bacteriologist, retired, of the Indian Service of the British Government, died at the age of seventy-four years on March 29.

SCIENTIFIC EVENTS

GRANTS FOR RESEARCH OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

UPON recommendation of the Committee on Grants, consisting of Drs. J. G. Lipman (Agriculture), *chairman*, McKeen Cattell (Medical Sciences), Moses Gomberg (Chemistry), G. H. Parker (Zoology), F. K. Richtmyer (Physics), Joel Stebbins (Astronomy), Sam F. Trelease (Botany), and A. T. Poffenberger (Psychology), the council of the association has awarded grants in aid of research from the $2,000 fund appropriated for the year 1939 as follows:

Harold C. Bold, Vanderbilt University, for studies of the algal flora of the Highlands of North Carolina and in other portions of the southern Appalachian Mountains, $150.

Kendall B. Corbin, University of Tennessee Medical College, for investigation of the source and nature of the proprioceptive components of the cranial nerves, $200.

Frank H. J. Figge, University of Maryland, for continuation of investigations on the intra-cellular factors controlling enzymatic pigment formation, $250.

Arthur H. Graves, Brooklyn Botanic Garden, for attempts to develop, by breeding, a blight-resistant chestnut tree of a type suitable for timber to replace the now practically extinct American chestnut—*Castania dentata*, $200.

F. R. Hunter, Rhode Island State College, to study the relationship between the respiratory activity of the cell and its selectively permeable properties, $65.

Daniel Linehan, Weston College, to make a seismological study of the earthquake near Lowell, Massachusetts, of June 23, 1938, $80.

Isabelle W. Pfeiffer, Yale University, to aid in a histological study of the corpora allata of the grasshopper, *Melanoplus differentialis*, in correlation with various physiological conditions, particularly those relating to moulting and reproduction, $75.

Christianna Smith, Mount Holyoke College, for the study of the rat embryonic liver in its hematopoietic stage by the tissue culture method to elucidate the origin and differentiation of red blood corpuscles, $100.

M. L. Pool, Ohio State University, to construct a beta-ray spectrograph suitable for measuring the beta-ray spectra of artificial radioactive nuclei; the gamma-ray spectra to be measured by Compton recoil electrons, $300.

H. S. Reed, University of California, Berkeley, to provide help for clerical and bibliographical assistance, for photostats, and possible short trips to other libraries, in connection with preparation of a book on the history of the plant sciences, $150.

Elizabeth S. Russell, Jackson Laboratory, to continue a study of the genetics, histology and physiology of the various benign and malignant tumors in the fruit-fly, *Drosophila melanogaster*, $230.

Sherwin F. Wood, Los Angeles City College, to determine insect reservoirs for *Trypanosoma cruzi* Chagas in the state of Texas and the virulence of these insect infections for white-footed mice, $200.

SUMMER BOTANICAL MEETINGS IN VIRGINIA, WISCONSIN AND CALIFORNIA

DR. GEORGE S. AVERY, JR., secretary of the Botanical Society of America, writes that there will be three regional meetings of the society during June, the first at the Mountain Lake Biological Station, Mountain Lake, Virginia, on June 15, 16 and 17; the second at the University of Wisconsin on June 21, 22 and 23, and the third at Stanford University from June 26 to July 1.

The Mountain Lake gathering will be a joint meeting with the American Society of Plant Taxonomists, the Sullivant Moss Society, the American Fern Society, the Southern Appalachian Botanical Club and the Committee on Virginia Flora. The University of Virginia and the Virginia Polytechnic Institute will be joint hosts for this meeting. Field trips will be made into the surrounding mountain region during the day-time, and evening meetings will be held on the grounds of the Biological Station, and on the campus of the Virginia Polytechnic Institute. Accommodations with meals will be available in Blacksburg at $3 a day. At the Mountain Lake Biological Station, meals and lodging will be $2.00. Reservations may be made at either place by addressing Professor A. B. Massey, Blacksburg, Va.

The University of Wisconsin will be the host for the second meeting. This will be a joint meeting with the American Phytopathological Society, the American Society of Plant Physiologists, the American Society of Plant Taxonomists and the Mycological Society of America. Both field and formal meetings will be held. Accommodations will be available at various hotels at minimum rates of from $2.50 to $4. The University Club will have a few rooms available. Reservations may be made directly with the hotels or with the University Club.

Dr. Ira L. Wiggins, secretary of the Pacific Section, announces that the Stanford University gathering will be a joint meeting with the Pacific Division of the American Association for the Advancement of Science. It will include joint symposia and other meetings with the Western Sections of the American Society of Plant Physiologists, the Ecological Society of America and the American Society of Plant Taxonomists. A field trip is arranged for Ano Nuevo Point, an area about forty miles from Stanford where coastal sand dunes, a partially submerged deposit of peat, vegetation along a brackish lagoon, etc., can be examined. Housing accommodations will be available in the dormitories at the rate of $2.00 per day for the first three days, and $1.75 thereafter. Reservation requests should be addressed to Miss Anastasia Doyle, Box 1772, Stanford University. Three hotels in Palo Alto, a mile from the university, offer accommodations for approximately forty-five transient guests at rates varying from $1.25 to $4. Early reservations are urged because of the demand for rooms during the Golden Gate Exposition. Meals may be obtained at the Stanford Union. Full information will be mailed to members at an early date.

MEDALS OF THE FRANKLIN INSTITUTE

THE complete list of recipients in 1938 of the various medals awarded annually by the Franklin Institute, Philadelphia, Pa., as recommended by its Committee on Science and the Arts, has been announced by Dr. Henry Butler Allen, secretary of the institute, as follows:

The Franklin Medal, awarded annually from the Franklin Medal Fund, founded January 1, 1914, by Samuel Insull, Esq., "to those workers in physical science or technology, without regard to country, whose efforts, in the opinion of the Institute, acting through its Committee on Science and the Arts, have done most to advance a knowledge of physical science or its applications." To Edwin Hubble, Ph.D., D.Sc., LL.D., Mount Wilson Observatory, Carnegie Institution of Washington, Pasadena, "In recognition of his extensive study of the nebulae, particularly those outside our galaxy, as a result of which the dimensions of observed space have been greatly increased."

The Franklin Medal posthumously to Albert Sauveur, Sc.D., D.Eng., professor emeritus of metallurgy and metallography, Harvard University, "In recognition of his outstanding work in the science of metallography and of his many contributions to this branch of metallurgy which have been in a large measure responsible for changing the heat treatment of steel from an art to a science."

The Edward Longstreth Medal, founded in 1890 by Edward Longstreth, of Philadelphia, retired member of the Baldwin Locomotive Works, for the encouragement of invention. To Arthur C. Hardy, Sc.D., professor of optics and photography, Massachusetts Institute of Technology, "In consideration of the development of an accurate and reliable instrument which has greatly expedited research in the field of color, both in theory and in its commercial applications." To Jesse E. Stareck, Ph.D., Waterbury, Conn., "In consideration of the development of a new technique for the study of electrode phenomena encountered in the electrolysis of water solutions and the discovery of a new method applicable to the art of coloring metals." To John Strong, Ph.D., assistant professor of physics in astrophysics, California Institute of Technology, and to Robley Cook Williams, Ph.D., department of astronomy, University of Michigan, "In consideration of their independent development and improvement of a process for coating astronomical mirrors with a layer of metallic aluminum deposited thereon by evaporation in vacuo."

The John Price Wetherill Medal, founded in 1925 by the family of John Price Wetherill, to be awarded for discovery or invention in the physical sciences, or for new and important combinations of principles or methods already known, to William Albert Hyde, director of research, Leon J. Barrett Company, Worcester, Mass., "In consideration of his discovery and development of a process for the centrifugal impregnation of objects which has materially reduced the time necessary for impregnation as compared with the prior art."

The George R. Henderson Medal, founded in 1924 by Mrs. Virginia P. C. Henderson, in memory of her husband, George R. Henderson, consulting mechanical engineer connected with Baldwin Locomotive Works. He was also a long-time member of the Franklin Institute and served as chairman of its Committee on Science and the Arts and as a member of its Board of Managers. The medal is awarded for distinguished contributions in the field of railway engineering. This year it will be presented to Ralph Budd, president, Chicago, Burlington and Quincy Railroad Company, Chicago, Illinois, "In consideration of his engineering ability, vision and courage in carrying out railroad construction in difficult mountainous terrain in the Northwestern part of our country, and of his other contributions in the field of railway engineering."

The Louis E. Levy Medal, founded in 1923 by the family of Louis E. Levy, Philadelphia, a member of the Committee on Science and the Arts of the Franklin Institute at the time of his death, who had previously served the institute as a member of the Board of Managers for twelve years and a vice-president for three years, is awarded "to the author of a paper of especial merit, published in the *Journal* of the Franklin Institute, preference being given to one describing the author's experimental and theoretical researches in a subject of fundamental importance." It will be given to Kalman John DeJuhasz, associate professor of engineering research, Pennsylvania State College, "For his article entitled 'Graphical Analysis of Surges in Mechanical Springs,' which appeared in the October and November, 1938, issues of the *Journal* of the Franklin Institute."

The Howard N. Potts Medal, founded, by will, in 1906, by Howard N. Potts, a life member of the institute and a member of the Bar in Philadelphia, is awarded for "distinguished work in science or the arts; important development of previous basic discoveries; inventions or products of superior excellence or utilizing important principles." It will be awarded to Newcomb K. Chaney, Ph.D., director of research, United Gas Improvement Company, Philadelphia, Pa., "In consideration of his original and successful work in the hitherto uncharted field of carbon activation," and to H. Jermain Creighton, Sc.D., professor of chemistry, Swarthmore College, Swarthmore, Pa., "In consideration of his distinguished work in developing a process for the electrolytic reduction of simple sugars on a large scale."

The Elliott Cresson Medal, founded in 1848 by Elliott Cresson, of Philadelphia, Pa., a philanthropist and successful merchant who lived from 1796–1854, is awarded for recognition of distinguished contributions in the realm of physical science. It will be awarded to George Ashley Campbell, Ph.D., Upper Montclair, N. J., retired research engineer, American Telephone and Telegraph Company, "In consideration of his lifelong study of the theory of electric circuits, resulting in notable contributions to the science that underlies telephony and to inventions of fundamental importance in the art." To John R. Carson, Sc.D., research mathematician, Bell Telephone Laboratories, Inc., New York, New York, "In consideration of outstanding contributions to the art of electrical communication," and to Charles Vernon Boys, F.R.S., LL.D., London, England, "In recognition of the scientific achievements of Sir Charles Vernon Boys, which have furnished scientists with new and remarkably precise methods for making measurements in gravitation, in sound, in heat, in radiation, in current and static electricity so refined as to render possible the weighing of the earth, the determination of the radiant energy coming to us from the stars, the photography of the speeding bullet and the immobilization, even, of the lightning flash itself."

Certificate of Merit, presented jointly to Percy Russell, D.D.S., Wilmington, Delaware, and E. Burke Wilford, president, Pennsylvania Aircraft Syndicate, Philadelphia, Pa., "In consideration of the development and application of a simple means of regulating and controlling the speed of small electric motors."

The presentation of the medals and certificates will be made at 3:30 P.M., on the afternoon of Wednesday, May 17, in Franklin Hall, at formal exercises presided over by Philip C. Staples, president of the Franklin Institute. At this session Dr. Hubble will read an original paper on "The Motion of the Stellar System Among the Nebulae." Mrs. Albert Sauveur will be present to accept the award of the Franklin Medal to Dr. Sauveur.

At 7:30 P.M., on the evening of the same day, a subscription dinner in honor of the medalists will be held in Franklin Hall.

MEDALS OF THE NATIONAL ACADEMY OF SCIENCES

PRESENTATION of the medals of the National Academy of Sciences was made at the annual dinner of the academy on April 25. These were as follows:

Agassiz Medal for Oceanography, awarded to Harald Ulrik Sverdrup, of the Scripps Institution of Oceanography of the University of California, La Jolla, for his personal oceanographic explorations in Arctic regions and his numerous contributions to physical oceanography and the interrelations between the sea and the atmosphere. The presentation address was made by Dr. T. Wayland Vaughan, emeritus professor of oceanography of the University of California and emeritus director of the Scripps Institution, who was chairman of the committee at the time the award was recommended to the academy.

Daniel Giraud Elliot Medal for 1933 and Accompanying Honorarium of $200, awarded to Richard Swann Lull, of the Peabody Museum of Natural History, Yale University, in recognition of his work entitled: "A Revision of the Ceratopsia or Horned Dinosaurs," published in the *Memoirs* of the Peabody Museum of Natural History. The presentation address was made by Dr. William Berryman Scott, emeritus professor of paleontology of Princeton University.

Daniel Giraud Elliot Medal for 1934 and Accompanying Honorarium of $200, awarded to Theophilus Shickel Painter, of the University of Texas, in recognition of his work on the chromosomes of the salivary glands in Drosophila in relation to the problems of mutation and genetics, published in *Genetics* and the *Journal of Heredity* in 1934. The presentation address was made by Dr. Ross G. Harrison, of Yale University, chairman of the committee on the Daniel Giraud Elliot Fund.

The John J. Carty Medal and Award for the Advance-

ment of Science, consisting of a gold medal, bronze replica, certificate and $3,000 in cash, awarded to Sir William Bragg, of the Royal Institution, London. Sir William is distinguished by his fundamental work in x-ray crystal analysis. He has shown how to reveal the constitution of crystalline forms and accurately measure them, and his studies have given birth to a new tool which is bringing to light important facts regarding such complex structures as the larger organic molecules. Dr. Frank B. Jewett, chairman of the Committee on the Carty Fund, stated the reasons for the award, and Dr. A. H. Compton, of the University of Chicago, spoke on Sir William's work.

ELECTIONS OF THE NATIONAL ACADEMY OF SCIENCES

AT the annual meeting of the National Academy of Sciences, held in Washington on April 24, 25 and 26, Dr. Frank B. Jewett, president of the Bell Telephone Laboratories, was elected president for a term of four years, to succeed Dr. Frank R. Lillie, emeritus professor of zoology of the University of Chicago, who will retire on June 30.

New members of the academy were elected as follows:

Gregory Breit, professor of physics, University of Wisconsin.

Detlev Wulf Bronk, Johnson professor of biophysics and director of the Johnson Foundation, University of Pennsylvania.

William Bosworth Castle, associate professor of medicine, Harvard Medical School, director of the Thorndike Memorial Laboratory, Boston City Hospital.

Frederick Gardner Cottrell, president, Research Associates, Incorporated, Washington, D. C., consulting chemist, Bureau of Chemistry and Soils.

Frederick Parker Gay, professor of pathology and bacteriology, College of Physicians and Surgeons, Columbia University.

Albert Baird Hastings, Hamilton Kuhn professor of biochemistry, Harvard University.

Vladimir Nikolaevich Ipatieff, research director of the Universal Oil Products Company, professor of chemistry, Northwestern University.

Merkel Henry Jacobs, professor of general physiology, University of Pennsylvania.

Zay Jeffries, General Electric Company, Cleveland, Ohio.

Donald Forsha Jones, geneticist, Connecticut Agricultural Experiment Station, New Haven.

George Bogdan Kistiakowsky, professor of chemistry, Harvard University.

Warren Judson Mead, professor and head of the department of geology, Massachusetts Institute of Technology.

Oscar Riddle, investigator, department of genetics, Station for Experimental Evolution, Carnegie Institution, Cold Spring Harbor, N. Y.

Adolph Hans Schultz, associate professor of physical anthropology, School of Medicine, the Johns Hopkins University.

Philip Edward Smith, professor of anatomy, College of Physicians and Surgeons, Columbia University.

Foreign associates elected were:

Sir Joseph Barcroft, professor of physiology, the University of Cambridge.

Sir William Bragg, director, the Royal Institution of Great Britain and Fullerian professor of chemistry and director of the Faraday Research Laboratory.

Dr. F. A. Vening Meinesz, professor of geodesy and cartography, the University of Utrecht.

Dr. Frederick E. Wright, of the Geophysical Laboratory, Carnegie Institution of Washington, was reelected home secretary for a term of four years, and Dr. Charles August Kraus, professor of chemistry at Brown University, and Dr. Alfred Newton Richards, professor of pharmacology at the University of Pennsylvania, were elected members of the council to succeed Dr. Simon Flexner, director emeritus of the Rockefeller Institute for Medical Research, and Dr. J. B. Whitehead, director of the school of engineering of the Johns Hopkins University.

SCIENTIFIC NOTES AND NEWS

THE John L. Lewis Prize of the American Philosophical Society has been conferred on Dr. Henry Norris Russell, professor of astronomy and director of the observatory at Princeton University, "in appreciation of his contribution on 'stellar energy,' at the society's symposium on astrophysics in February." The presentation was made by Dr. Harlow Shapley, director of the Harvard College Observatory, at the annual dinner of the society on April 22. Dr. Roland S. Morris, formerly United States Ambassador to Japan and president of the society, presided. The speakers included Dr. Vannevar Bush, president of the Carnegie Institution of Washington; Dr. Victor G. Heiser, of the International Leprosy Commission, and Professor Jesse S. Reeves, of the University of Michigan.

AT the closing session of the meeting in Washington of the American Geophysical Union, Dr. William Bowie was made the first recipient of a newly established Bowie Medal, named in his honor, "for distinguished attainment and outstanding contribution to the advancement of cooperative research in fundamental geophysics." Dr. Bowie joined the U. S. Coast and Geodetic Survey in 1895 and from 1909 until his retirement in 1936 was chief of the Division of Geodesy.

THE British Society of Antiquaries, London, will award its gold medal this year for distinguished services to archeology to Dr. Haakon Shetelig, keeper of the Bergen Museum. He received the medal at the anniversary meeting, which was held at Burlington House on April 27.

THE prize of $1,000, established by Mead Johnson and Company, was awarded at the Toronto meeting of the American Institute of Nutrition to Dr. C. A. Elvehjem, professor of agricultural chemistry at the University of Wisconsin, in recognition of his work with nicotinic acid as a cure for pellagra.

THE sixth award of the Edward Goodrich Acheson Medal and the $1,000 prize of the Electrochemical Society was presented at the Columbus meeting on April 26 to Dr. Francis Cowles Frary, director of the Research Laboratories of the Aluminum Company of America and known for his achievements in the metallurgy of aluminum. Previous recipients of the award are: Dr. Edward Goodrich Acheson, for his work on artificial graphite; Dr. Edwin F. Northrup, for the invention of the high frequency electric furnace; Dr. Colin G. Fink, for his contributions to electrochemistry; Dr. Frank J. Tone, for his work on carborundum, and Dr. Frederick M. Becket, for his contributions to electrometallurgy.

PROFESSOR CLAUDE RIGAUD has received the award of the Katherine Berkan Judd Prize of the Memorial Hospital for the Treatment of Cancer and Allied Diseases for the year 1938. The prize, which carries a stipend of $1,000, is for his "pioneer contributions in the field of radiophysiology and therapy." Dr. Rigaud was for many years director of the Curie Institute, Paris, and since his retirement has been engaged in research in the Pasteur Institute, Paris.

THE A. W. Hoffmann Memorial Medal has been awarded by the German Chemical Society to Dr. Albert Szent-Györgyi, professor of medical chemistry at Szeged, Hungary.

THE Lobatchewsky Prize of the Mathematical Institute of Kazan has been awarded to Professor Élie Cartan, of the University of Paris.

PETER P. T. SAH, professor of organic chemistry at the Catholic University, Peking, China, has been elected to the Kaiserlich Deutsche Akademie der Naturforscher in recognition of his work in vitamin research.

M. JACQUES DUCLAUX, professor of general biology in the Collège de France, Paris, has been elected a free academician of the Paris Academy of Sciences, in succession to the late M. d'Ocagne.

DR. BERTHOLD HATSCHEK, professor of zoology at the University of Vienna, celebrated on April 3 the eighty-fifth anniversary of his birthday.

AT the Toronto meeting of the Federation of American Societies for Experimental Biology, Dr. Oscar Henry Plant, professor of pharmacology of the University of Iowa, was elected president of the American Society for Pharmacology and Experimental Therapeutics and, by a system of rotation among the societies, also became chairman of the executive committee of the federation. The next meeting of the federation will be held in New Orleans.

AT the annual meeting of the Electrochemical Society, held at Columbus, Ohio, the following officers were elected: *President,* H. Jermain Creighton, Swarthmore College; *Vice-presidents,* D. A. Pritchard, Montreal; Alexander Lowy, Pittsburgh; J. D. Edwards, New Kensington, Pa.; *Managers,* C. E. Williams, Columbus; K. G. Soderberg, Detroit; J. A. Lee, New York City; *Treasurer,* Robert M. Burns, New York City; *Secretary,* Colin G. Fink, Columbia University.

IT is stated in *Nature* that at a plenary session of the Academy of Sciences of the U.S.S.R. recently held in Moscow the following officers were elected: *President,* V. L. Komarov; *Vice-presidents,* O. J. Schmidt, the late I. M. Gubkin, E. A. Chudakov, A. A. Bogomolets, A. J. Vishinsky, T. D. Lysenko, V. N. Obrazcov, A. E. Fersman. The secretaries of the eight newly constituted departments of the academy, elected at a previous session of the academy, become *ex-officio* members of the Presidium. They are: Department of Economics and Law, E. S. Varga; Department of Technical Sciences, V. P. Nikitin; Department of History and Philosophy, A. M. Deborin; Department of Geology and Geography, P. I. Stepanov; Department of Biology, L. A. Orbeli; Department of Physico-Mathematical Sciences, A. N. Kolmogorov; Department of Languages and Literature, I. I. Meshchaninov; Department of Chemistry, A. N. Bakh.

PROFESSOR ALPHEUS G. WOODMAN, professor of chemistry at the Massachusetts Institute of Technology, has been made emeritus professor.

DR. TRACY J. PUTNAM, professor of neurology at the Harvard Medical School and neurologist-in-chief of the Boston City Hospital, has been appointed professor of neurology and neurosurgery at the Columbia University School of Medicine. Dr. Putnam will also be the director of services of neurology and neurosurgery at the Neurological Institute of the Columbia-Presbyterian Medical Center. Dr. Vernon W. Lippard, director of the Commission for Study of Crippled Children of the City of New York, has been appointed assistant dean of the school. Drs. Charles A. Flood and Lawrence W. Sloan have resigned as assistant deans to enter private practice.

ANNOUNCEMENT has been made of a number of pro-motions and appointments at the Yale School of Forestry, effective on July 1. These staff changes have been occasioned by the retirement of Dean Henry S. Graves and the death of Professor Ralph C. Bryant. As previously announced, Professor Samuel J. Record has been named dean of the school. He will also carry the title of Pinchot professor of forestry. Dr. George A. Garratt, associate professor of forest products, has been appointed Manufacturers' Association professor of lumbering, to fill the vacancy created by the death of Professor Bryant. Dr. Harold J. Lutz, assistant professor of forestry since 1933, has been promoted to an associate professorship. Dr. Walter H. Meyer, professor of forest management at the University of Washington, has been appointed associate professor of forestry, to fill the teaching vacancy created by the retirement of Dean Graves. Robert T Clapp has been promoted to an assistant professorship, on the Charles Lathrop Pack Foundation, and will serve as director of the Yale Forests and of the summer term of the School of Forestry, as well as giving instruction during the regular college year. Robert W. Hess, assistant professor of forestry at the University of Maine, has been appointed assistant professor of forest products, to fill the vacancy resulting from Professor Garratt's promotion to the professorship of lumbering. Professor Hess was formerly associated with the University of Arkansas.

Dr. Alfred C. Callen, of the University of Illinois, has been appointed head of the department of mining engineering and dean of the College of Engineering at Lehigh University. Dr. Bradford Willard, of the Pennsylvania Topographical and Geologic Survey, has been appointed head of the department of geology, and Professor Gilbert E. Doan, of the faculty, head of the department of metallurgical engineering. Relinquishing their administrative work under an age rule of the board, but continuing on the teaching faculty are: Professor Bradley Stoughton, dean of the College of Engineering and head of the department of metallurgical engineering; Professor Benjamin L. Miller, head of the department of geology, and Professor Howard Eckfeldt, head of the department of mining engineering.

Dean Robert C. Disque, of the School of Engineering of Drexel Institute of Technology, has been appointed educational consultant in planning and carrying out the cooperative system of education in the Institute of Technology to be established at Northwestern University through the $6,735,000 gift of the Walter P. Murphy Foundation. He will assume the position left vacant by the recent death of Dean Herman Schneider, of the University of Cincinnati, founder of the cooperative plan, who was originally selected as adviser to the new institute by Northwestern University and the Walter P. Murphy Foundation.

Dr. James G. Horsfall, chief in research in plant pathology at the New York State Experiment Station at Geneva since 1929, has resigned to become head of the department of plant pathology and botany at the Connecticut Agricultural Experiment Station at New Haven.

M. J. Goss, of the Industrial Farm Products Research Division of the Bureau of Chemistry and Soils, has been appointed technical assistant in the general organization of the Regional Research Laboratories which are being established by the U. S. Department of Agriculture.

Dr. Norman W. Krase, professor of chemical engineering at the University of Pennsylvania, has been appointed by the E. I. du Pont de Nemours and Company to take charge of all semi-works operations for the ammonia department of the chemical division, with headquarters at the Experimental Station, Wilmington, Del. He will begin his new work at the end of the present academic year.

Dr. Juan Negrin, formerly professor of physiology at the University of Madrid, who was premier of the Spanish Republican Government, sailed for New York on April 26.

Franklin C. McLean, professor of pathological physiology at the University of Chicago, writes: "Professor Otto Loewi has been released from Germany. He may be addressed in care of Club de la Fondation Universitaire, Rue d'Egmont, Brussels. Before being released he was stripped of all his property, both inside of and outside of Germany, including his Nobel prize money, which had never been in either Austria or Germany. Mrs. Loewi is still detained in Germany."

Colonel Joseph F. Siler, director of the Army Medical School, delivered the annual Kober Lecture at Georgetown University Medical School, Washington, D. C., on March 28, on a new vaccine for typhoid developed by the army. He was presented with a check for $500, provided under the terms of the Kober Foundation.

The John Torrey lecture in botany of the Torrey Botanical Club was delivered by Dr. P. R. White, of the Rockefeller Institute for Medical Research, Princeton, New Jersey, before the club and the Columbia Institute of Arts and Sciences on Friday evening, April 21. He spoke on "Tissue Cultures in Plants."

Dr. George B. Kistiakowsky, professor of chemistry, Harvard University, will deliver the Edgar Fahs Smith Memorial Lecture at the University of Pennsylvania on May 26. His subject will be "Energetics of Some Organic Molecules."

DR. WALTER B. CANNON, George Higginson professor of physiology at Harvard University and president of the American Association for the Advancement of Science, spoke on "Serendipity" or "An Accidental Sagacity" at the second annual meeting of the Wellesley Chapter of Sigma Xi on April 28.

DR. ALBERT D. MEAD, professor of biology, emeritus, will give the Graduate School Convocation address at Brown University on June 17. His subject will be "The Species Complex."

THE Association for Research in Human Heredity meets at the New York Academy of Medicine on May 5 at 8: 30 P.M. Dr. Alan Gregg, of the Rockefeller Foundation, is chairman. The speakers and their subjects are Dr. Nolan D. C. Lewis, the New York State Psychiatric Institute, "Evaluation of Present Research on the Genetics of Mental Disease," and Dr. Leslie T. Webster, the Rockefeller Institute for Medical Research, "The Role of Inborn Resistance in Infectious Disease."

A MEDICAL center, built at a cost of $1,000,000, on Mt. Scopus, Jerusalem, will be dedicated on May 9. Funds for the building were provided by the American Jewish Physicians' Committee and by Hadassah, the Women's Zionist Organization of America.

THE new observatory at the University of Glasgow was opened on April 18 by Sir Arthur Eddington, Plumian professor of astronomy at the University of Cambridge and director of the Cambridge Observatory. Sir Arthur was introduced by Sir Hector Hetherington, principal and vice-chancellor of the university, who said that it was the third observatory of the department of astronomy. It would be used not so much for observation as for instruction and the training of students in the use of astronomical instruments. The new observatory consists of a laboratory, an astronomy room, a dome for the 7-inch refractor and a house for the transit instrument. Before the opening ceremony Sir Arthur lectured on "The Expansion of the Universe."

DISCUSSION

THE FIRST EXPERIMENT IN PLANT PHYSIOLOGY

ACCORDING to texts in general botany and plant physiology and to a representative series of books on the history of biology and the history of botany, the first experiment in plant physiology was performed by Van Helmont in the seventeenth century, the familiar and oft-cited five-year test, during which a five-pound willow shoot grew to a weight of one hundred and sixty-nine pounds, while its supporting soil, starting at two hundred pounds, lost only two ounces. That Van Helmont was first to perform this experiment is so generally accepted that a divergent opinion was a matter of special interest. According to Charles Singer ("From Magic to Science," 1928), credit for this experiment really belongs to a man of two centuries before Van Helmont, Nicholas Krebbs (1401–1464), usually set down as Cusanus or Cardinal Nicholas de Cusa (Cues or Kues). Singer writes: "He records a careful experiment of a growing plant—afterwards pirated by the seventeenth century writer, Van Helmont (1577–1644)—proving that it absorbs something of weight from the air. This is the first biological experiment of modern times, and incidentally the first formal proof that air has weight."

As a matter of interest and record, translations of the statements of Cusanus and of Van Helmont are reproduced below for comparison. The Van Helmont excerpt was made by E. J. Russell, as quoted in *Plant Physiology* (1929). The Cusanus translation comes from an English edition of a small part of his writings published in 1650, six years after Van Helmont's death, and bearing the following title page:

> The Idiot, in four books. The first and second of Wisddome. The third of the Minde. The fourth of statick Experiment. or experiments of ballance. By the famous and learned C. Cusanus. London. Printed for William Leake, and are to be sold at the signe of the Crowne in Fleet-Street, between the two Temple Gates, 1650.

From Van Helmont:

I took an earthen vessel in which I put 200 pounds of soil dried in an oven, then I moistened with rain water and pressed hard into it a shoot of willow weighing five pounds. After exactly five years the tree that had grown up weighed 169 pounds and about three ounces. But the vessel had never received anything but rain water or distilled water to moisten the soil when this was necessary, and it remained full of soil, which was still tightly packed, and, lest any dust from outside should get into the soil, it was covered with a sheet of iron coated with tin but perforated with many holes. I did not take the weight of the leaves that fell in the autumn. In the end I dried the soil once more and got the same two hundred pounds that I started with, less two ounces. Therefore the 164 pounds of wood, bark, and root arose from the water alone.

From Cusanus:

Orator. "There is a saying, that no pure element is to be given, how is this proved by the Ballance?"

Idiot. "If a man should put an hundred weight of earth into a great pot, and then take some Herbs, and Seeds, & weigh them, and then plant or sow them in that pot, and then should let them grow there so long, untill he had successively by little and little, gotten an hundred weight of them, hee would finde the earth but very little diminished, when he came to weight it againe: by which he might gather, that all the aforesaid herbs, had their weight from the water. Therefore the waters being ingrossed (or impregnated) in the earth, attracted a terrestreity, and by the operation of the Sunne, upon the Herb were condensed (or were condensed into an Herb.) If these Herbs bee then burn't to ashes, mayest thou not guesse by the diversity of the weights of all: How much earth thou foundest more than the hundred weight, and then conclude that the water brought all that? For the Elements are convertible one into another by parts, as we finde by a glass put into the snow, where we shall see the aire condensed into Water and flowing in the glass. So wee finde by experience, that some water is turned into stones, as some is into Ice; and there is in some fountaines a hardening and petrifying vertue, which turns the things that are put into them, into stone. For so say they, there is a certain water found in *Hungary*, which through the power of the vitriall which is in it, turneth Iron into Copper; for by such powers and vertues, it is manifest that the waters are not purely elementary, but elementated. And it were pleasant to have the weights of all these waters, of such divers vertues, that by the diversity of their weights in aire & oyle, one might come the nearer to the conjectures of their vertues.''

Whether Cusanus actually performed one or more specific experiments with plants of the type indicated probably can not be certainly determined. It is obvious, however, that he had a true concept of experimental method long before any one else is known to have put it to trial, so far as botany is concerned. That he probably did actually perform many tests with balances seems indicated by the circumstantiality of the phraseology. This opinion seems further confirmed by the fact that this plant experiment was not merely alone; the text contains others so factually correct that they practically eliminate the possibility that his citation of them may have been due to *a priori* reasoning. Two others are given below for their evidence of Cusanus's objective and inductive point of view.

> *Orator.* ''Might not the breath of a man be so weighed?''
>
> *Idiot.* ''There is one weight of the same man, when he draws in or holds his breath, another when he breathes it out; one weight of a man whilest he lives, another when he is dead; And so in all living things. And therefore it were good to have these differences noted, in divers living things, and divers men, and divers ages of men, that so by conjecture, a man might ascend to the weight of the vitall spirits.'' . . .
>
> *Orator.* ''How may the strength of a man be known by this means?''
>
> *Idiot.* ''Make a paire of scales even, then let a man lay hold of one of them, and in the other put as much weight as he can by the utmost of his strength pluck up from the ground till the balance be even: (which will be found more true (say I) if he have a rest to stay one or both his feet against) then take the weight of that which he hath pulled up, and deducting the weight of the man himself, all the remainder of the weight is portioned to his strength.''

When all the circumstances are considered, the question of credit for the first experiment in plant physiology seems to be resolvable about as follows: The works of Cusanus were extant and perhaps fairly well known in the seventeenth century, but his chief reputation then, as to-day, came from his contributions in the field of cosmology and philosophy, known from his influence on Giordano Bruno. In his experimentation, he had been so far ahead of his time that little attention had been paid to such matters of precision. By the seventeenth century, however, the intellectual soil had been cultivated further. Harvey had demonstrated the circulation of the blood. Francis Bacon had strongly advocated the use of the inductive method, and in his Sylva Sylvarum (1627) had described "ten centuries" of experiments, including not a few in plant physiology. Some of these are given in general terms, like the Cusanus account above, but others are as circumstantial as the Van Helmont experiment, and some even include carefully stipulated controls. Botanists will find in this Bacon work the forerunners of a variety of plant experiments. Since Sylva Sylvarum, published posthumously, antedated Van Helmont apparently by twenty-four years, it would appear that the question of priority for the first experiment in plant physiology lies between three men, rather than between two, with Van Helmont probably third in the series.

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METHOD OF ENTRANCE OF CERTAIN FISH INTO AN ESTUARY

THE factors responsible for the migration of fish into an estuary are not as yet fully understood. Various theories, some of them incorporating an "instinctive" behavior, have been put forward to explain certain phases of these migrations, but scientific investigation tends to discredit such theories, and places instead great importance on the influence of certain purely environmental factors.[1,2,3,4]

The mouth of the five-mile long tidal part of the Margaree River in Nova Scotia is of such a nature that it offers an excellent opportunity for studying the passage of certain fish into and out of the estuary. The common estuarine fish of this river is the stickleback, *Gasterosteus aculeatus*, and large numbers are

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[1] A. G. Huntsman, SCIENCE, 85: 313–314, 1937.

[2] E. B. Powers, *Publ. Puget Sound Biol. Sta.*, 3: 1–22, 1921.

[3] V. E. Shelford and E. B. Powers, *Biol. Bull.*, 28: 315–334, 1915.

[4] H. B. Ward, *Ann. Mag. Nat. Hist.*, 10: 6, 18–36, 1930.

carried from the estuary periodically with the outflowing tide. They gather at the ends of the breakwaters forming the narrow harbor mouth, and eventually, when the strength of the current has decreased sufficiently, make their way against it back into the estuary.

Two of the factors found to influence the entrance of sticklebacks into this estuary are (1) current and (2) low salinity, or something associated with it. Lyon[5] has described the orientation of fish in a current, and states that the normal tendency for a fish is to orient itself against the direction of current flow. Sticklebacks at the mouth of the Margaree exhibited just such a behavior. If they left their position in slowly moving water at the end of the breakwater to breast faster currents emerging from the river, they were carried back out again, but if the velocity of the outflowing water was not more than 1½ feet per second, their "cruising speed" was sufficient to take them into the harbor. At the turn of the tide, when the water became motionless, their orderly orientation was destroyed. With the commencement of the flooding tide, fish were seen to turn about and, stemming the current, make their way out of the estuary, which recalls Rutter's[6] account of the behavior of migrating quinnat salmon in San Francisco Bay. Such actions suggest the lack of any purposeful behavior in the migration of these fish, for they might be expected to swim in and regain their natural habitat at such times when entry could be most easily accomplished.

Sticklebacks at the mouth of the estuary were found to be attracted by river water. At the end of one of the breakwaters, they were frequently subjected to a second current of water in addition to that flowing from the estuary. Depending upon the direction of the wind, this second current consisted either of salt water from outside or of fresher river water which had left the estuary a short time before. In the latter case, fish would enter it in much the same manner that they breasted the current from the river, even though it did not lead into the estuary. When it was salt water that produced the current, fish shunned it. The results of an experiment performed with sticklebacks in a trough, in which they were subjected to currents of fresh and salt water of the same temperature entering at one end, gave added support to the indication that river water is attractive to these fish. Of the three dozen individuals used in the trough experiment, there were always twice as many fish in the current of river water as there were in the salt. *Menidia* and *Fundulus* reacted similarly. Whether the influence of the fresher water was due merely to its lower salt content or perhaps to the fact that it contained materials from the land was not determined.

HAROLD M. ROGERS

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COMPOUND WORDS IN PRESENT-DAY ENGLISH

I WONDER if philologists and students of style have noticed that, at least in scientific writing, the English language is rapidly acquiring a facility in forming compound words comparable to that possessed by ancient Greek and contemporary German? Such is undoubtedly the fact. As yet, our technique is rather awkward; the elements of a compound are written as separate words, and the resultant construction, if taken literally, would often defy parsing. But its essential nature is quite clear.

The new usage seems to be wholly unpremeditated and instinctive. There is something in the air; though trained in quite different methods, I find myself unconsciously eliminating prepositions and compressing phrases into compound words.

Thirty years ago every one, probably, would have written "Department of Biology." Now half the colleges in the United States have "Biology Department," or the like, on their stationery. Certainly, thirty years ago no one would have put forth such a title as "Cost Analysis of Scholarly Periodical Printing." Then it would have read: "An Analysis of the Cost of Printing Scholarly Periodicals." In time, as we become more definitely conscious of what we are doing, it may read: "Costanalysis of Scholarlyperiodicalprinting."

The whole phenomenon may serve as an illustration of the mysterious manner in which changes in language (and some other things) take place. Learned men in any number might have argued for years that compounds were convenient, concise and generally desirable in English, and have produced no more effect than have the advocates of "reformed" spelling. But, all at once, there comes some sort of inner urge—some mental epidemic—and the thing is done.

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SPECIAL CORRESPONDENCE

SCIENTIFIC WORK OF THE TENTH SOKOL FESTIVAL

THE Sokol is a national movement conceived in 1862 by Dr. Miroslav Tyrš, lecturer in the history of art at the Czech University in Prague, as a means of stimulating the cultural and political regeneration of the Czech people. Abroad it is recognized largely as a gymnastic organization, but behind the pageantry of its mass drills lies an almost unsurpassed example of what may be achieved in the way of scientific research through voluntary cooperative effort. The impetus given to the Sokol movement by Tyrš and Fügner almost a century ago has been continuously kept alive, for in its ranks, which numbered 800,000 before Munich, have stood some of Czecho-Slovakia's most distinguished men. From its very inception the Sokol and its history have been colored by the names of scientists. Dr. Eduard Grégr, Jan Evangelista Purkyně's assistant in the Prague Physiological Institute, contributed to the drafting of the association's first statutes.[1] He records that Tyrš attended Purkyně's lectures, and there are indications that this great, nineteenth century experimental physiologist influenced the formulation of a Czech physical education nomenclature and the selection of the Sokol's fundamental exercise program. The aged Purkyně himself took part in the physical activities of the Sokol, being one of a group of celebrated scholars of the university who trained under the direction of Malypetr. It is not strange, therefore, to find that from this heritage has grown an idea of service to the Sokol through science, which finds among its several outlets an admirable program of research pertaining to exercise.

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[5] E. P. Lyon, *Amer. Jour. Physiol.*, 12: 149–161, 1904.

[6] C. Rutter, *Bull. U. S. Fish Com.*, 22: 65–141, 1902.

Once every six years a Sokol Congress is held in which as many as 100,000 persons of both sexes participate, ranging in age from elementary school children to adults in the fourth and fifth decades. Medical examination is compulsory before entering into competition. Some of the events require great strength and neuromuscular skill, but the majority are adjusted to the capacities of average individuals in good health, accustomed to systematic exercise of a moderate type. The participants in the Pan-Sokol Festival are selected in preliminary district trials and thus probably represent the best physical specimens of the community at large. It is evident that the Sokol Slet offers a unique opportunity of assaying the physical status of a people and of studying innumerable problems in the physiology of exercise.[2]

At the instigation of medical research groups within the membership of the Sokol, a wooden building was constructed in 1932 to house rooms for scientific investigation and first aid during the ninth Slet. Since then the Ministries of Public Health and Physical Education, Public Works and Finance have erected an excellent research institute in the new northern wing added to the chief tribune of the Masaryk State Stadium at Strahov, Praha.[3] This included a series of rooms so arranged that large numbers of subjects might pass from one division of the examination to the next without interruption. Dressing rooms were so placed that either men or women might enter special units, such as the x-ray room. There was space for an electrocardiagram, a dark room, chemical laboratory and a surgical unit consisting of a preparation room, operating room and a sick room, the latter reserved for injuries or gynecological accidents too severe to permit the moving of patients to a hospital. The surgical unit was equipped without cost by Anýž and by Čížek. Its work was carried on by Professor Jirásek, chief of the First Surgical Clinic of Charles University, and the volunteer services of members of his medical and nursing staff. Vinopal loaned and installed without recompense two large x-ray units, the first of complete Czech make (Meta), and Foma contributed a fine grade of x-ray paper of Czech manufacture.

Early in the year all clinics were given an opportunity to submit projects for the tenth congress to a committee of the Sokol. This work was administered by Docent Jiří Král, Faculty of Medicine, Charles University, and a member of the League of Nations Committee of Experts on Physical Education. A brief résumé of the studies undertaken between May 29 and July 6, 1938, follows:

Dr. Klímová-Fügnerová, physician of the State Institute of Hygiene, and Dr. Záhoř examined the vision of Sokol children.[4] For those with acuity less than 5/10, ophthalmoscopic examination was provided. Dr. Klaus, of Professor Jerie's First Gynecological Clinic, Charles University, granted consultations to women participants in the upper age groups, studying the gynecological troubles appearing during the days of most strenuous exercise. Professor Ostrčil and his associates in the Second Gynecological Clinic, investigated the menstrual cycle of adolescent participants. Calendars were distributed, to be returned to the clinic after six months. His object was partly educational, that of teaching the young girl the importance and values of an accurate calendar record of the menstrual rhythm. At the previous Slet, Dr. Tillerová-Šebková had conducted an extensive interrogatory study to ascertain the influence of Sokol exercise upon child-bearing.[5] It had been suggested that labor is more difficult among those who participate in athletics. Professor Jirásek determined by x-ray and clinical examination the status of the joints of runners and the influence of their activity upon them.[6] Dr. Šiška, member of the second surgical clinic Charles University under the direction of Professor Diviš, studied the feet of the same runners and checked the condition of operated hernias among male participants.

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[1] J. Masák, *Tyršův Sborník*, 9, 1924.

[2] J. Král, *Věstník ČSl.Lékařů*, 50: 1030, 1938.

[3] M. Vejchoda-Ambros, *Ministry of Pub. Health and Phys. Ed.*, Praha, 1938.

[4] M. Klímová-Fügnerová, *Věstník ČSl.Lékařů*, 50: 1037, 1938.

[5] Z. Tillerová-Šebková, *Praktický Lékař*, 16: 175, 1936.

[6] A. Jirásek, *Věstník ČSl.Lékařů*, 50: 1032, 1938.

Under the leadership of Dr. Račanský, chief orthopedic surgeon of the Bat'a Hospital at Zlin, 10 physicians from Zlin and 10 consultants from the clinics of Professor Zahradníček and Professor Frejka made foot measurements, plantograms and noted foot defects. They were assisted by 10 technicians from the Bat'a factory, who are normally employed as modelers for shoe lasts. Record cards in different colors lightened the work of separating the data accumulated on country and city children. The incidence of various foot defects in young people was studied, and those requiring medical attention were directed toward proper treatment. From the measurements and plantograms, the foot types of children will be determined and lasts constructed for shoes to fit these feet. Dr. Gellért, director of the Department of Internal Medicine of the Bat'a Hospital, investigated constitutional types among Sokol boys, studying in particular the relationship of habitus to foot defects, especially to flat feet. About 1,500 children were examined in this series of studies alone, and the work was entirely financed by the Bat'a factory.

Professor Hynek, chief of the First Clinic of Internal Medicine, Charles University, Docent Král and Dr. Baštecký made teleroentgenograms of the hearts of 500 Sokols. During the last Slet they had studied the post-exercise decrease in the size of the heart,[7] and had observed the frequency of mitral configuration in young adult men and women.[8] This year they added observations on adolescent boys and on men selected from amongst the oldest competitors. Electrocardiograms were also made on the latter group. It is Professor Hynek's ultimate plan to compare these large series of teleroentgenograms with observations on sedentary subjects, contributing to the still open question of the influence of exercise upon the heart. Professor Prusík, of the Propedeutic Clinic, commenced a study of syncope during the last Slet. Working with Professor Vondráček, the project was continued, making blood chemistry studies and observing the efficacy of the administration of salt as a preventative against fainting.[9]

The whole of this program was conceived and executed by Sokols. Professional services, furnishings, costly equipment and valuable supplies were voluntarily contributed. The actual research was conducted by experienced investigators under the leadership of men of the highest rank in the medical profession of Czecho-Slovakia, most of them connected with the Medical Faculty of the Czech University in Prague. All Sokols, familiar with the philosophical and practical aspects of this organization's exercise program, they were in a unique position to appreciate its problems, sense their importance and bring to bear upon them the fruits of a rich and varied scientific experience. Therein probably lies the motivating force behind the scientific work of the Tenth Sokol Festival.

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JIRÍ KRÁL

CHARLES UNIVERSITY, PRAGUE

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[7] J. Král and B. Polland, *Časopis Lékařů Českých*, 73: 541, 1934.

[8] K. Hynek, J. Baštecký and J. Král, *Cong. International de Méd. Appliqué a l'Éd. Phys. et aux Sports*, Chamonix-Mont Blanc, 1934.

[9] B. Prusík, *Věstník ČSl.Lékařů*, 50: 1033, 1938.

SPECIAL ARTICLES

THE EFFECT OF SEX HORMONES ON THE NORMAL RESISTANCE OF RATS TO CYSTICERCUS CRASSICOLLIS[1]

IT is generally recognized that sex is an important factor in the incidence and severity of certain diseases. Experimentally, this is especially apparent in working with controlled larval tapeworm (*Cysticercus crassicollis*) infections in rats where, in most cases, the degree of infection in normal females is only about 60 to 80 per cent. of that found in normal males.[2] That this sex difference is statistically significant is clearly shown by the investigations of Curtis, Bullock and Dunning.[3] In order to ascertain whether this sex difference could be altered by sex hormones, theelin and testosterone propionate[4] were injected into normal male and female rats, which were subsequently infected with a standardized dose of *Taenia taeniaformis* eggs.

A preliminary experiment carried out with the aid of Mr. I. G. Arnason suggested that the degree of infection might be altered under certain conditions by the injection of sex hormones. However, since the degree of the experimental infection was too low to afford adequate analysis, the work was repeated and the following more significant results were obtained which for the most part confirmed the earlier observations.

The animals were young adult virgin female and male albino rats weighing approximately 100 grams.

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[1] This investigation was aided in part by the Mr. and Mrs. Frank G. Logan fund and in part by a grant from the Rockefeller Foundation to the University of Chicago.

[2] By personal correspondence, it has been learned from Dr. V. N. Moorthy, of the India Health Service, that a similar condition exists in human infection of *Dracunculus medinensis*. Under conditions in which males and females are equally exposed to infection, the disease is less prevalent in the latter.

[3] M. R. Curtis, W. F. Dunning and F. D. Bullock, *Am. Jour. Can.*, 17: 894, 1933.

[4] The theelin was supplied by Dr. Cartland, of the Upjohn Company, and the testosterone proprionate by Dr. Schwenk, of the Schering Corporation.

Methods used for determining the resistance of rats against infection with *C. crassicollis* have been previously described by the author.[5] Fifteen males and 15 females in one group were given 14 consecutive daily injections of 0.5 cc of sesame oil alone. Fifteen males and 15 females in a second group were given 14 consecutive daily injections of 0.5 cc sesame oil containing 0.005 mgm (5 International Esterogenic units) of theelin. A third group of 15 males and 15 females received 14 daily consecutive injections of 0.5 cc of sesame oil containing 0.6 mgm (equivalent to 40.2 International Androgenic units) of testosterone proprionate. All animals were inoculated at the time of the last injection. Seven weeks after infection the animals were sacrificed and the average number of parasites (cysts) determined by macroscopic examination of the livers. The average degree of infection in each group is given in Table 1. The normal sexual variation in resistance to infection is clearly brought out in Group 1. For example, the average infection of the control group of females was only 67 per cent. (42 × 100/62) of that found in the control group of males (difference of 20 ± 3.1). The infection in females which received theelin was essentially the same as the untreated controls (3 ± 2.6), but the males which received theelin showed a slightly lower degree of infection than the untreated control males (12 ± 3.2). The theelin appeared to increase the resistance of males slightly, and the results probably would have been more pronounced had the animals been castrated. On the other hand, females which received male sex hormone showed a marked decrease in resistance to infection as compared to the normal females (18 ± 3.5), which was approximately the same as that shown by the untreated control males, whereas males which received male sex hormones showed no change in resistance.

TABLE 1

THE AVERAGE NUMBERS OF *Cysticercus crassicollis* FOUND IN NORMAL RATS AND IN RATS TREATED WITH EITHER THEELIN OR TESTOSTERONE PROPIONATE

Group	Number of rats and sex	Treatment	Average number of cysts (± P.E)
1	15 males	Sesame oil	62 (± 2.15)
	15 females		42 (± 2.06)
2	15 males	Theelin	50 (± 2.49)
	15 females		45 (± 1.62)
3	15 males	Testosterone propionate	64 (± 1.97)
	15 females		60 (± 2.86)

It appears, therefore, that the normal sexual variation in resistance of rats to *C. crassicollis* can be modified by the injection of sex hormone, but any explanation of such reactions must await further investigations on the physiological and cellular effects of such substances.

The author is particularly indebted to Professor F. C. Koch for his aid in this investigation.

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[5] Dan H. Campbell, *Jour. Immunol.*, 35: 195, 1938.

THE ANTIDERMATOSIS VITAMIN REQUIRED FOR REPRODUCTION IN THE DOMESTIC FOWL

THE antidermatosis vitamin[1] is the water-soluble factor which prevents the dermatosis or pellagra-like syndrome of the chick, first described by Ringrose and Norris[2] and obtained in aggravated form on the Wisconsin heated diet.[3] Although dermatosis in chicks has been frequently observed in the experimental laboratory, no evidence that the mature fowl suffers from a deficiency of this vitamin has yet been reported. Hence a study of this problem was initiated, the results of which are presented in this report.

White Leghorn pullets were used as the experimental subjects in this study. The control group of pullets was fed the following diet, designated the normal diet:

	Per cent.
Yellow corn meal	40.65
Wheat bran	20.00
Wheat flour middlings	20.00
Purified casein	7.00
Liver extract	0.35
Soybean oil	5.00
Wheat germ oil	0.50
Cod liver oil	0.50
Pulverized limestone	3.50
Steam bone meal	2.00
Iodized salt	0.50
Manganese carbonate	trace

The remaining pullets were fed the same diet except that the cereal portion and the liver extract were heated in an oven for 36 hours at 120° C. in order to destroy the antidermatosis vitamin. This diet was designated the heated diet.

By proper attention to composition and through appropriate biological assays the heated diet was demonstrated to contain all the vitamins known to be required by the domestic fowl or not yet shown to be required, with the exception of the antidermatosis vitamin and the new growth and reproduction factor reported by Bauernfeind *et al.*[4, 5] These are vitamins A, B_1, B_4, B_6, D, E, K, riboflavin (G), nicotinic acid and the antiencephalomalacia factor.

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[1] Called filtrate factor by the California workers.

[2] L. C. Norris and A. T. Ringrose, SCIENCE, 71: 643, 1930.

[3] O. L. Kline, J. A. Keenan, C. A. Elvehjem and E. B. Hart, *Jour. Biol. Chem.*, 99: 295, 1932.

[4] J. C. Bauernfeind, A. E. Schumacher, A. Z. Hodson, L. C. Norris and G. F. Heuser, *Proc. Soc. Exp. Biol. and Med.*, 39: 108, 1938.

[5] J. C. Bauernfeind, A. E. Schumacher, A. Z. Hodson, L. C. Norris, and G. F. Heuser, *Poul. Sci.*, 17: 444, 1938.

The new growth and reproduction vitamin was added to the heated diet by means of a whey adsorbate and the antidermatosis vitamin by means of a rice bran concentrate.[6] This concentrate had been treated several times with fuller's earth to remove vitamin B_1, riboflavin and most of vitamin B_6. The concentrate was assayed in accordance with the procedure of Jukes and Lepkovsky[7] and found to have an antidermatosis value of 25.

At the start the hens were divided into two groups, one of which was fed the normal diet and the other of which was fed the heated diet in order to deplete the hens in this group of their reserves of the antidermatosis vitamin. This was determined by studying the hatchability of the eggs laid by this group. Weekly hatches were conducted during a depletion period of 7 weeks. The average hatchability of the eggs of the hens fed the normal diet during the depletion period was 63.9 per cent., while that of the hens fed the heated diet was 15.8 per cent. The hatchability of the latter group decreased to 2.7 per cent. during the depletion period. No improvement in the hatchability of this group was obtained by supplementing the heated diet first with 5 per cent. of the antidermatosis-vitamin concentrate and finally with 10 per cent.

Since it was recently found that the heated diet was also deficient in a new growth and reproduction factor, labile to dry heat treatment, the hens fed this diet were divided into three groups. One group was fed the heated diet as heretofore, a second group was fed the heated diet plus 5 per cent. of whey adsorbate containing the new factor, and a third group was fed the heated diet plus 5 per cent. of whey adsorbate and 5 per cent. of the antidermatosis vitamin concentrate. Their response in hatchability of eggs to these treatments was compared to that of the group of hens fed the normal diet. The results are presented in Table 1.

TABLE 1

HATCHABILITY RESULTS OBTAINED DURING THE EXPERIMENTAL PERIOD

Pen	Number eggs set	Number hatches	Per cent. hatch
1. Normal diet	232	6	60.0
2. Heated diet	115	6	2.8
3. Heated diet + 5 per cent. whey absorbate	139	6	3.3
4. Heated diet + 5 per cent. whey adsorbate + 5 per cent. antidermatosis vitamin concentrate	136	6	48.0

The average hatchability of the eggs of the hens fed the normal group was 60.0 per cent. during the experimental period, while that of the eggs of the hens fed the heated diet was 2.8 per cent. When 5 per cent. of whey adsorbate was added to the heated diet no improvement in hatchability was obtained over that on the heated diet. But when both 5 per cent. of whey adsorbate and 5 per cent. of antidermatosis vitamin concentrate were added to the heated diet the hatchability increased rapidly so that at the third hatch it was approximately equal to that of the hens fed the normal diet. The average hatchability of this group of hens during the experimental period was 48.0 per cent.

The hens were fed the heated diet for a period of 28 weeks without any macroscopic evidence of dermatosis developing and without any effect upon egg production or mortality. When a similar heated diet was fed to the chicks of normally fed hens, dermatosis did not develop until the chicks were 14 days of age. But when the chicks of hens nearly depleted of the antidermatosis vitamin were fed in a like manner, symptoms of dermatosis appeared at three to four days of age. This is evidence that the hens fed the heated diet deposited less of the antidermatosis vitamin in their eggs than the hens fed a normal diet.

It is concluded from the results presented in this report that the antidermatosis vitamin is required for hatchability or reproduction in the domestic fowl but that a lack of this vitamin did not affect egg production or mortality during the period represented by this experiment.

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INDUCED PARTHENOCARPY OF WATERMELON, CUCUMBER AND PEPPER

PARTHENOCARPIC fruits, induced by means of hormones in lanolin paste, have been secured by Gustafson[1] in tomato, pepper, crookneck summer squash, Hubbard squash, eggplant and some ornamental plants. Several attempts were made to induce fruit set in watermelon and pumpkins, but failed. The result in cucumber was also discouraging.

Gardner and Marth[2] obtained parthenocarpic fruits in American holly and strawberry by spraying the pistillate flowers with different concentrations of hormones. Wong[3] in Florida found that indoleacetic and indole-propionic acids in lanolin paste did not induce parthenocarpic fruit, although parthenocarpy did exist in both seedless and seedy varieties of some common oranges in Florida.

While natural parthenocarpy commonly occurs in banana, Washington Navel and Valencia oranges,

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[6] Prepared by Vitab Products, Emeryville, California.

[7] T. Jukes and S. Lepkovsky, *Jour. Biol. Chem.*, 114: 117, 1936.

[1] F. G. Gustafson, *Proc. Nat. Acad. Sci.*, 22: 628–36, 1936; *Am. Jour. Bot.*, 24: 102–7, 1937; *Bot. Gaz.*, 99: 840–4, 1938.

[2] F. E. Gardner and P. C. Marth, *Bot. Gaz.*, 99: 184–95, 1937.

[3] Cheong-yin Wong, unpublished data, 1937.

Marsh grapefruit, Sultanina graps and some Chinese persimmons it is rare in watermelon and American cucumber and has not been reported in peppers.[4, 5]

An experiment was conducted by the writer during the summer of 1938 with the National Pickling variety of cucumber, in an attempt to secure seedless fruits with normal shape by means of growth-promoting substances. There were 8 series of experiments. All the treated blooms were covered with wire cages before anthesis as well as 4 to 6 days after treatment in order to avoid contamination. It was found that natural parthenocarpy occurs in this variety, but the occurrence is very rare. Naphthalene acetic acid caused parthenocarpic fruits either when applied in lanolin paste of 1 per cent. to 5 per cent. concentrations or as a 0.05 per cent. aqueous solution. The percentage of fruit set in hormone-treated flowers was higher than from self-pollination.

With watermelon, eleven varieties were used. Both indolebutylic and naphthalene acetic acids (NAA in short) were used. These were applied as 1.0, 2.5, and 5.0 per cent. concentration in lanolin paste and as a NAA 0.05 per cent. aqueous solution. Twelve different treatments were used. No parthenocarpic fruits were formed except from blossoms treated with NAA. Fruits were induced to set by treating the cut style in all concentrations of lanolin paste and possibly in aqueous solution. Hormone-treated watermelons were perfectly seedless but varied in fruit shape. In general, the hormone-treated fruits were more or less triangular in shape, some even resembling the Table Queen squash rather than watermelon. Some, however, were normal in shape and size. The texture of these fruits was very solid and firm. No differences in flavor could be detected from normally pollinated fruits.

The seed of three plants of the Winter Sweet watermelon had been subjected to colchocine treatment before planting. The plants showed a typical colchicine effect, *i.e.*, stunting early in the season, large size of leaves and flowers and great vigor later in the season. Although pollen was present in great abundance, it failed to induce fruit setting when the blossoms were selfed. On the other hand, hormone-treated flowers set very satisfactorily. Fruits were formed in some open-pollinated flowers (with plenty of seeds), probably due to fertilization from nearby normal plants (vicinism).

Very satisfactory results were obtained in pepper of the Harris Wonder variety, both by using 1 per cent. of NAA in lanolin and spraying with 0.05 per cent. aqueous solution.

A detailed report will be published elsewhere in the near future.

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[4] H. A. Jones and J. T. Rosa, "Truck Crop Plants," p. 437, 1928.

[5] R. Wellington and L. R. Hawthorne, *Am. Soc. Hort. Sci. Proc.*, 25: 97–100, 1929.

SHORTENING DAYLIGHT PERIODS BETWEEN MAY 15 AND SEPTEMBER 12 AND THE PELT CYCLE OF THE MINK[1]

ONE of us[2] found that the pelt cycle of the ferret (*Putorius vulgaris*) is conditioned by length of day in correlation with the sexual cycle under the control of the hypophysis. This cycle was controlled and modified by manipulating the daily period of light to which the animals were exposed.

In a rather crudely and irregularly carried out experiment last summer, mink (*Lutreola vison*) were used as experimental animals, to see if this nearly related animal was responsive in the same way. The experiment was carried out in a cellar, where the temperature was not controlled and varied with the season but within somewhat narrower limits than that outside in the full light of day.

Controls consisted of about fifty mink of both sexes kept in the usual type of pen outside in the daylight and fed and cared for in the usual way. Some had distemper and some had not. Experimental animals consisted of four males and twelve females kept in the cellar in cages similar to those of controls. None of them had the distemper and all remained in good health and condition throughout the experiment. They were introduced into the cellar at four different times between May 15 and June 16.

By closing light-tight shutters over the two windows of the cellar, the light-time each day was gradually reduced from May 15 to June 23; increased gradually until July 26, because nothing seemed to be happening to the first animals introduced. It was then gradually reduced again until September 12. This second reduction was given because on July 26 it was noted that three of the animals (2 ♂♂ + 1 ♀) were in the condition of fur normal for the first week of October. They were shedding summer pelt and growing winter pelt from the tails forward. All experimental animals were removed from the cellar and returned to normal daylight on October 24. For two weeks, beginning on August 22, one male and one female that seemed to be slow to change pelt were placed in a refrigerator for from one-half to two hours each second day to see if reducing temperature would hasten their reaction or improve their winter pelts. All animals were fed the usual summer diet of red meat (until September 15).

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[1] Aided by grants from the National Research Council, Committee for Research in Problems of Sex, 1937–38, and the Penrose Fund of the American Philosophical Society, 1938–39, administered by T. H. Bissonnette.

[2] T. H. Bissonnette, *Anat. Rec.*, 68 (2): 159–168, 1936; *Quart. Rev. Biol.*, 11 (4): 371–386, 1936; *Endocrinology*, 22 (1): 92–103, 1938.

Controls put on winter prime pelts at the usual time in October and early November or later, whether they had distemper or not.

Six of the experimentals reached normal winter prime pelt before September 18, except for slight reddish color due to the red meat diet: one female before August 17, the hottest of summer time; two others before September 1 and 6; two males before September 12 and one before the 18th. Another female barely failed to complete prime coat before September 12 and two others (♂ + ♀) loosened summer fur but failed to grow winter pelt except on the tail. Refrigeration may perhaps have helped one male slightly toward prime coat; but it was completely ineffective with the female similarly treated.

Other experimental females failed to show any change of pelt except to have a few hairs become loose in September and October and failed to assume prime winter pelt even at the usual time before November 7. They were apparently rather drastically upset by the irregular changes in length of day just about the time they were beginning to become responsive.

It is, therefore, indicated that the assumption of winter prime pelt by mink may be induced in summer in spite of relatively high temperatures or hastened in autumn by reducing the duration of the periods of light (and/or its intensity) to which the animals are exposed daily. Reduced temperature is, apparently, at most, a minor factor in this reaction.

The complete experiment will be described in detail elsewhere.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A GLASS AND RUBBER LABORATORY PUMP

The pump to be described here is a modification of one designed by Palmer.[1] Like Palmer's, it is operated by compressed air, and the fluid being pumped is in contact with glass and rubber only. It has the added advantages of greater capacity—1,500 cc per minute against a pressure of over a meter has been attained—and of operating in any position.

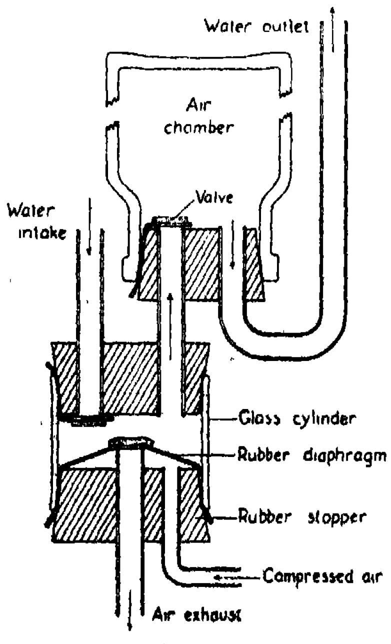

Fig. 1. Section of pump.

The construction is shown in Fig. 1. The cylinder is made of a piece of Pyrex tubing with an internal diameter of two inches. Considerable strength is necessary, but for pumps built on a smaller scale Pyrex need not be used. The diaphragm and valves are of rubber dam about 1/40 inch thick. They must not be stretched too tightly. *Ecru* dam should be used; the "buckskin" rubber dam popular with dentists fails after two or three weeks. The life of these parts is increased by attaching with rubber cement a small piece of rubber (*e.g.*, inner tube) to the diaphragm and to each valve, as shown in the figure. The ends of the tubes over which the valves and diaphragm fit should be ground to an even rim and fire polished. All stoppers must be wired in place.

A head of water (or of whatever fluid is to be pumped) is necessary at the intake. This fills the cylinder, pressing down on the diaphragm, and passes up through the air chamber and outlet tube to a height equaling the head at the intake. When the compressed air is turned on, the diaphragm is lifted, closing the intake valve and driving the water through the outlet, but the weight of the water, opposed only by atmospheric pressure in the exhaust, holds the diaphragm against the end of the exhaust for some time. Finally, the increasing pressure below the diaphragm lifts it off the exhaust, allowing the air to escape and the diaphragm to fall. As it falls, the cylinder is refilled through the intake, the exhaust is closed, and the process starts again. Each cycle moves only three or four cubic centimeters of water, but the pump operates at about six strokes per second. The flow of compressed air must be carefully adjusted by a clamp close to the pump to achieve the maximum rate of pumping; too rapid flow will cause the diaphragm to buzz without accomplishing anything. The pump is sometimes temperamental about starting. Very often the trouble can be traced to faulty construction, but it is also true that valves and diaphragm improve after they have been in place for a time. Once started, the pump will run for weeks without attention. Sometimes the air is slowly absorbed from the air chamber and must be replaced. This can be done by blowing air through the intake. The pump will work in any position, but the air chamber must be more or less vertical with the stopper down.

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[1] J. Palmer, Science, 80: 229–230, 1934.

High efficiency depends chiefly upon well-fitting valves and rapid inflow. As many as four parallel intake tubes have been put in with very satisfactory results. The writer has for the most part used the pump simply submerged in the barrel of sea water that was being circulated. The exhaust tube was, of course, extended to a point above the surface of the water.

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AN INEXPENSIVE WARM STAGE

A warm stage is a very useful addition to the microscope, particularly for such investigations as the demonstration of motile amoebae in stools. Where only an occasional examination is made, the cost ($15 to $20) is likely to be prohibitive.

A very serviceable stage can be made at a trivial cost from an electric iron heating element. This comes copper clad and slotted as shown in the drawing. It draws 550 watts at 110 volts, becoming red hot. However, if it is connected to the secondary terminals of a bell-ringing transformer, it does not take much current and rises to a temperature of 40° C. or less. By connecting a 6-ohm radio rheostat in series, the current can be regulated so as to maintain a temperature of 37° C.

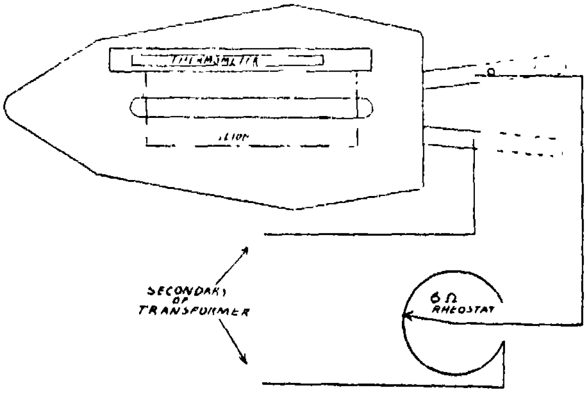

Fig. 1

The construction is quite simple. With a hack-saw or grindstone, remove most of the side of a piece of ⅛″ pipe about 3½″ long, leaving both ends. This furnishes the thermometer carrier. The slot enables the operator to read the temperature. Lay the element on a piece of asbestos and connect the terminals to the 110-volt mains. The element becomes quite hot in a few seconds. Place a strip of solder about ½″ from the slot. Place the pipe on the molten solder and disconnect the electric current. When cool, the pipe will be firmly fastened to the element. Cut off the portion of the element terminals shown in dotted lines and solder wires to them. Connect these wires to the transformer through the rheostat.

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THE INTERRELATION OF SOILS AND PLANT, ANIMAL AND HUMAN NUTRITION[1]

By Dr. E. C. AUCHTER

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OUR knowledge of many aspects of the interrelations between soils, plants, animals and human beings is limited, but some of the work that has been done in recent years gives us fascinating glimpses of the possibility and importance of further discovery. I would go so far as to say that we can now see the outlines of a whole new field of biological, or shall I say, agricultural, research. From what is already known, this phase of agricultural research should lead to a new orientation of agricultural thinking. Certainly it suggests profound implications for human welfare.

The interrelation of the soil, the atmosphere, the plant and the animal is a cycle in which the same materials are used over and over again. Minerals, moisture and certain constituents of the atmosphere under proper conditions of light and temperature enter the plants, and by them compounds of potential energy are made and the excess over their own utilization stored. When such products are eaten by human beings and animals, these compounds are broken down and reworked, energy becomes available for growth and movement, and parts of the compounds are again released into the air in the form of carbon dioxide and moisture or returned to the soil. Such compounds may then be taken up again by plants and rebuilt into new plant bodies. Thus there is an obvious interrelationship, the animals being dependent upon plants, the plants upon soil, and the soil upon parent rock and the materials that are returned to it through the decay of plants and animal products. Thus a great cycle or *wheel of life* is established, constructive processes balancing the destructive; the whole, a cycle of energy exchange, which in modifying animal and human development also modifies the whole complex of thought, emotion, happiness, sorrow and the other factors affecting life.

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[1] Address of retiring vice-president and chairman of Section O (Agriculture) of the American Association for the Advancement of Science, Richmond, December, 1938.

In our scientific procedure so far, we have more or less neglected the interrelationship between soil, plants, animals and man, although in nature this is a fact, a reality. We have been prone to consider the problems of each separately rather than to study them as a whole.

Fairly early in the development of modern science, specialization became necessary, and to-day we have reached the point where the whole of science is rather minutely departmentalized. Each department has its own language and traditions and pursues its own objectives. By this method, we have accumulated a vast amount of information—for example, regarding the classification, chemical and physical properties and management of soils; and regarding the growth and reproduction of plants and animals. Chemistry, physiology, anatomy, pathology, physics, genetics, bacteriology and other sciences have all contributed to the knowledge concerning these subjects but each in its separate department.

That method was necessitated by the vastness and complexity of the facts with which science deals, and it is still necessary. But the unity of nature no less than its complexity is important, and the time has come when we shall have to pay more attention to this unity without neglecting the advantages of specialization.

This is not a new or original idea. It is part of the mental atmosphere of our time, and this association has given a good deal of thought to the possibility of closer coordination between the sciences. But what suggests it strongly to me, with my particular interest in agricultural research, is the direction taken by recent developments in the science of nutrition, both plant and animal, and the parallels or closeness of association of the two.

These developments emphasize the importance to the health of man and animals of certain mineral elements, vitamins, hormones and other factors. At the same time, we are discovering that deficiencies of certain elements essential to the health of the animal organism exist in some soils, while other soils have accumulations of harmful substances. Hitherto the principal objective of many of our plant investigations has been to adjust soil-management practices, change environmental conditions, and in many cases modify the above-ground portions of the plant in order to obtain as large crop yields as possible. But these developments in the science of nutrition suggest that we ought to give more attention to producing crops of the highest *nutritional* quality for man and animals. That would be worth doing even if it should involve a sacrifice in yield, which should not happen, but which, if it did, would run counter to the main trend of our work in the past.

That is what I meant when I said that these interrelationships might affect the orientation of agricultural thinking and practice. Obviously here is a case where an interrelationship must be studied—the interrelationship between the physical well-being of man and the factors in the soil that affect the composition and development of plants. The investigations should include thorough studies of proteins, amino acids, carbohydrates, fats, vitamins, enzymes, hormones, other growth accessory substances, the ordinary minerals and the so-called "trace" or "rare" elements and their effects upon man. Knowledge of the nutritional significance of some of these factors has increased rapidly as a result of research during the past twenty-five years. What we need especially to do now is to put together the various parts we do know so that in acquiring new knowledge we can move forward on a unified front.

MINERAL REQUIREMENTS OF PLANTS AND ANIMALS

Plants are dependent on the soil, particularly the nutrients in it, among other things, for their best development and growth. In turn, man and animals are dependent upon plants for their existence. Thus the soil is the mother of all living things. In addition to carbon, hydrogen and oxygen, plants apparently need at least the following chemical elements for normal development: Calcium, phosphorus, potassium, magnesium, sulfur, nitrogen, iron, manganese, boron, copper and zinc. Certain elements, such as boron, are required in relatively small quantities but may be definitely toxic if present in too large amounts.

Animals require all these, with the possible exception of boron, and in addition sodium, chlorine, iodine and cobalt. The possible value of such elements as nickel, bromine, arsenic, lead and fluorine, together with some of the rarer elements, such as molybdenum, strontium, vanadium, uranium, caesium and others sometimes found in the ash of plants, still remains in question. They may be needed to perform certain functions or they may simply be absorbed by plants or eaten by animals with their food, exciting little or no physiological effects. We do know that certain elements such as selenium, thallium, fluorine, arsenic and lead, if present in too large quantities, are definitely toxic to both plants and animals. Our present information indicates that they are undesirable soil constituents even at low concentrations. Undoubtedly, in the future additional elements may be found to be essential for the best development of plants, man and animals.

Elements essential for the normal development of plants apparently occur in sufficient quantities in many soils, yet the normal requirements of the plants for each of the elements may differ considerably. Thus boron, zinc, copper, iron, manganese, iodine and cobalt are apparently needed only in relatively small amounts. These and others have come to be known as rare, trace or micro elements. Recent investigations in this and other countries have shown deficiencies of these elements in certain soil areas. Certain elements may have been present in only very small amounts during the formation of some soils, amounts insufficient for crop plants; or they may have become exhausted through continuous cropping or partially removed by drainage and erosion through the years. Frequently nutritive elements are present in soils in forms unavailable to plants and special treatment of the soil may be necessary to bring them into the soil solution. The unavailability of iron in calcareous soils, the greater availability of zinc in acid soils, and the "fixation" of phosphorus in many soils serve as examples.

SOME SOIL DEFICIENCIES RESULTING IN NUTRITIONAL DISORDERS OF PLANTS AND ANIMALS

Results of only a few of the more recent experiments have shown that the following physiological troubles of plants, among others, have been corrected by furnishing the necessary limiting elements: Sand drown of tobacco in the soils of the sandy Coastal Plain by magnesium; chlorosis of tomatoes on some of the calcareous soils in Florida by manganese; internal browning of cauliflower and dry rot of sugar beets in Michigan, crown rot of sugar beets in Ireland, and die-back of citrus in Africa by boron; pecan rosette in the South by zinc; internal cork and drought spot of apples in British Columbia, West Virginia and elsewhere by boron; citrus leaf mottle in California, South Africa and Florida by zinc; little leaf of apples and other deciduous fruits in the West and Northwest by zinc; cracked stem of celery in Florida by boron. Improved yields of potatoes, snapbeans, cabbage, lettuce, peppers, carrots, beets, citrus and corn result when manganese is applied to the calcareous soils of Florida, and white bud of corn on the Norfolk and Hernando fine sands in Florida is prevented with zinc. Improved growth of several crop plants occurs in the organic soils of Florida and the muck soils of Holland and parts of western New York when copper is added. Yellows of tea in Nyasaland, Africa, is corrected and growth of field crops in Oregon and other areas is improved by the addition of sulfur.

Many of the elements just mentioned are likewise important for the best development of man and animals. The necessity of sufficient amounts of calcium and phosphorus and a suitable ratio between them, together with Vitamin D, is recognized. According to Maynard[2] over 70 per cent. of the ash of the animal body consists of calcium and phosphorus, and approximately 99 per cent. of the calcium and 30 per cent. of the phosphorus of the body are present in the bones and teeth. The importance of calcium and phosphorus in bone building and the prevention of osteomalacia and rickets are thus easily understood.

It is not my purpose here to attempt a discussion of the roles of magnesium, sodium, potassium, chlorine, sulfur and zinc in animal nutrition. It is important to point out, however, that some of the rare or trace elements, now considered as essential to plants, likewise play an important part in human and animal nutrition and in the prevention of diseases. Thus iron, as a constituent of the respiratory pigment of haemoglobin, is essential for the functioning of every organ and tissue in the body and plays a fundamental role as a catalyst for cellular oxidation. Its importance, together with copper, in the treatment of nutritional anemia, is well known. Sometime ago in Australia, and more recently in New Zealand, the lack of cobalt in certain soils, and thus in the plants, has been determined as the cause of the so-called "bush sickness" of sheep; and the addition of cobalt is now preventing the trouble. Manganese is concerned in the physiology of reproduction and among other things prevents perosis in chickens. Magnesium is closely associated with calcium and phosphorus, both in its distribution and metabolism, and, among other things, appears to assist in the normal functioning of nerves.

The lack or unavailability of iodine in soils and crops results in human and animal goiter. Iodine-deficient areas exist in the Northwest, the Great Lakes region, and parts of Europe and Asia, such as the Alps, Tyrol, Pyrenees and Himalaya Mountains. Before iodine feeding was practiced in Montana it is estimated that goiter caused an annual loss of many thousands of pigs. According to Maynard, the principal demand for iodine in farm animals occurs during pregnancy.

THE PRODUCTION AND USE OF ENERGY

The importance of continuing investigations to determine which elements are essential not only for the best development of plants but for the production of the highest quality plants, which, when consumed, will meet the nutritional requirements of man and animals, is evident. Many factors affect the growth of plants and their value as food.

Nutrient materials must be either in solution or capable of becoming dissolved at the margin of the root hair before they enter the plant body. After their entrance, they become a part of the vast complex of compounds that make up the plant body, and when the plants are consumed by man or animals the nutrients included become part of their bodies. It is the capacity of green plants for manufacturing food—

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[2] Leonard A. Maynard, "Animal Nutrition." McGraw-Hill Book Company. 1937.

for accumulating energy as food—that makes them prominent in any system of economy dealing with living things. Green plants, in the presence of sunlight, accomplish this by combining the carbon dioxide of the air and water to form carbohydrates. The minerals and other substances absorbed by the plant from the soil, water or atmosphere are combined with the carbohydrates or other materials formed from them and help to make up such compounds as proteins, fats, vitamins and other growth and regulatory factors.

These combinations of foods, both simple and complex, found in plants, are the chief source of energy and are essential for the health of man and animals. The importance, therefore, of producing plants of the highest nutritional quality can easily be appreciated. In addition, the nutritive value of animal products, as regards mineral content and in a large part vitamins, is dependent on the plant foods they consume. This emphasizes the importance of knowing whether the necessary and desirable nutrients are available in the different soil types of the various regions in the country, to insure not only crop productivity but also that such crops may contain these elements. As previously mentioned, evidence indicates that this is not so in many instances. In other words, certain of the minerals are not present or available in sufficient amounts in some soils for the most satisfactory growth and development of many crop plants. It can be assumed, therefore, that the plants produced in such areas might not furnish certain of the important minerals and compounds needed for the best development and health of man and animals.

This fact takes on considerable significance when we realize that large segments of the population in certain areas of this and other countries obtain practically all their food directly from the plants or from animals that eat the plants produced in their own local communities. Although food products are better distributed to-day than ever before and more variety is available from a much larger area, thus lessening but not eliminating the possibilities of certain deficiencies, there are still great groups of people who are not in a position to purchase much food in addition to that which they produce. Accordingly, in such groups the diet is limited. Even in cities, certain low income groups have a restricted diet. Such dietary deficiencies no doubt result primarily from too low an intake of certain classes of foods, as milk, green vegetables, fish and lean meats. If such foods are also deficient in certain essential elements, the probability of physiological disturbances and reduced vitality is increased. The incidence of anemia has been reported to be especially high among school children in areas where soil deficiencies are known to be responsible for "salt-sick," an anemia-like condition in live stock.

In the past, serious bone, skin, digestive and nervous disorders, among other maladies, occurred in certain localities. It is now known that many of these troubles resulted from restricted diets or from eating plant and animal products produced on soils either deficient in certain elements or containing elements injurious to health. Even to-day there are regions where such troubles as goiter, skin diseases, weak and deformed leg bones, mottled and furrowed teeth and nervous disorders are all too common. A book by J. R. de La H. Marett,[3] entitled "Race, Sex, and Environment," should be read by those interested in this general field.

Another condition, not so striking as those just mentioned but still serious, is the lowered efficiency of certain groups of improperly fed people—people who, although they have no specific disease, have a lowered vitality and, in common parlance, are not up to par. The point I am trying to make is that there are degrees of health, and if conditions of lowered health exist in part because of low quality plant or animal products produced on deficient soils, then the plant, animal and soils investigators have a challenge and responsibility that can not be shirked.

I am well aware that dietary deficiencies among large groups of people can be traced to economic causes—the lack of sufficient income to obtain a good diet easily. But this rather emphasizes than minimizes the responsibility of the agricultural scientist to discover ways of improving limited diets. He may feel rather helpless when it comes to the question of how to increase the purchasing power of large numbers of people, but the other problem, improving the quality of the foods they do get, should be within his grasp.

FACTORS AFFECTING THE VALUE OF PLANTS AS FOOD

It is well recognized that the composition of plants grown on different soil types in the same climatic region varies in both organic and inorganic constituents. Analyses of the same kind of plant grown in different regions and showing striking differences in composition are recorded. It is realized that differences in climate existed, and in many cases evidence is lacking relative to the past and present soil-management practices, the species of plant, including the particular variety, its age and the stage of growth at sampling time as affecting composition. But even making such allowances the differences in percentages of some elements are so large as to leave little doubt that they are due to the presence or absence of certain elements in the soil.

It is well known that the chemical composition of plants, with respect to both their mineral and organic content, may be greatly changed by modifying various treatments, such as fertilizer, irrigation or pruning practices. It is thus possible to change the food value of the plants in either the fresh or the cured condition through methods of treatment and handling of the soil and plants. The nutritive value, succulence and crude fiber of crops may thus vary greatly, depending upon the amount and kind of fertilizer applied or the amount and time of applying irrigation water. In general, there is not a direct simple relation but a complex one between water supply and available nutrients. Increasing the amounts of mineral nutrients if water is deficient, or the available water if minerals are deficient, is ineffective in promoting crop yield. An abstract of a recent paper by Thomas, of the Ontario Agricultural College in Canada, entitled, "The Influence of Soil Type and Climate on the Chemical Composition of Fodder Plants," and presented before a symposium of the summer meeting of the American Association for the Advancement of Science at Ottawa in 1938, is significant in this connection. Among other things, he found that there were wide differences in the chemical composition, the crude fiber and ash of plants grown on different soil types, that there was a direct relation between the soil reaction and the percentage of calcium in plants, and that the composition of plants was decidedly influenced by the character of the season. An excellent discussion of this whole problem is presented in the book written by Orr[4] with the assistance of Helen Scherbatoff, entitled, "Minerals in Pastures." Various publications record differences in composition similar to those shown for forage crops in the case of plants used for human consumption.

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[3] J. R. de La H. Marett, "Race, Sex, and Environment," a Study of Mineral Deficiency in Human Evolution. Published by Hutchinson's Scientific and Technical Publications, 32–36 Paternoster Row, London, E. C. 4. 1936.

In addition to considering methods of handling the soil as regards the absorption and utilization of minerals, the synthesis of foodstuffs and energy accumulation by plants, attention must also be given to the way in which the top of the plant is managed as affecting these processes. Too often practices applied to the soil have been antagonistic in their effects to those applied to the part of the plant above the soil. Thus, the time of pruning or cutting plants in relation to their stage and type of growth as affecting later composition and response is important. The differences in palatability and composition of certain vegetables grown by different methods and at various stages of growth are well known. Investigators of the Bureau of Dairy Industry of the United States Department of Agriculture state: "Early-cut hay is more palatable, digestible, and nutritious. Protein content decreases and crude fiber increases with maturity. Proper curing and storage keeps leaves from shattering and retains a good green color—the best indicator of high vitamin A content."

It is important to recognize that, in addition to water and soil nutrients, attention must also be given to the quantity and quality of light received by the plants during their growth period. Thus by such practices as spraying, pruning and shading the horticulturist can influence the capacity of plants to synthesize, translocate and store carbohydrates. The agronomist accomplishes the same end by cutting, mowing, pasturage and other practices. The interrelation of the various cultural and management practices as affecting the composition and growth of plants has been well described by Kraus and Kraybill[5] and need not be discussed here.

SUGGESTED INVESTIGATIONS AND OBJECTIVES

Scientists have used water cultures for many years to determine those elements essential for plant growth and will continue to make valuable contributions by this method. Even though some food may be produced by this method in the future, still the great bulk of food needed for human and animal consumption must continue to be produced from the soils of the nation.

The importance, then, of knowing more about the soils of the country, with particular reference to their origin, chemical and physical composition, amenability to various treatments and effectiveness in producing plants of high quality seems clear. Much information on these points is already available, but one of the great needs now appears to be that of making accurate studies and complete analyses of agricultural soil types and areas and the crops that grow upon them under known conditions of climate, fertilization, variety, irrigation and stage of maturity, to determine if deficiencies or excesses of certain elements occur in such soils and plants, and, if so, to correct the conditions with the ultimate view of improving the health of human beings.

The fact that many of the sandy soils of the Coastal Plain, certain calcareous soils and the muck soils, as well as other types, are deficient in some of the minerals essential for plants, animals and man has been pointed out. Similarly, the presence of toxic elements such as selenium and fluorine in certain soil areas has been noted. Doubtless elements not now known to be essential may be found to be so in the future.

There is need for a concerted attempt to correlate composition of foods with soil type, climatic conditions and the practices followed in their production. In addition to those elements whose presence in food is of vital necessity, the fact that certain elements used in combating plant pests may be taken up from the foliage or the soil by the growing plant or may be found in solution in the water supply suggests the urgent need of investigation. A survey should be made of the occurrence of the various elements in fertilizer materials, sprays, dusts and the like. Such substances may definitely modify the composition of plants so that the plants either are more nutritious or become toxic to man or animals consuming them. Research should be pushed on the physiological effects of the so-called "rare" or "trace" elements previously mentioned and others not yet studied.

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[4] J. B. Orr and Helen Scherbatoff, "Minerals in Pastures." Published by H. K. Lewis and Company, Ltd., 1929.

[5] E. J. Kraus and H. R. Kraybill, *Oregon Exp. Station Bull.* 149, 1918.

Little is known in detail of the functions of most of these elements. Some of them may have subtle and far-reaching influences. Investigations should be made, therefore, of the nature or availability of the compounds occurring in soils and how they are affected by chemical and biological processes in the soil, of the periodicity of their intake or distribution within the plant, of the differences among species of plants or among strains within a species in their need for mineral elements and their ability to accumulate them and of the effects of chemical additions to the soil upon the composition of the plant.

Thorough plant physiological and anatomical studies should be conducted with reference to the absorption and effects of the various mineral elements, with special reference to the minor elements, including their effect on the elaboration of vitamins, hormones and other compounds. Studies should also be made of the factors influencing availability to the plants of these elements in various soils. The forms in which these various elements occur in plants and the tissues of the plant in which they are stored should be determined. This will involve both field and pot culture studies under carefully controlled conditions, and the further development of special techniques in handling such cultures and of improved analytical methods for the detection of minute quantities of the elements under study.

Consideration should also be given to the digestibility and utilization in the body of the various plant compounds in relation to other factors affecting metabolism and growth.

Studies should be made of the form in which the fertilizing elements are supplied—whether organic, inorganic, colloidal or otherwise and their effects on plant growth and composition. The claim is made that great differences result in the plants used as food, if the fertilizers used are "colloidal."

Consideration should also be given to the influence of such factors as light intensity, length of day, temperature, atmospheric humidity and inherent varietal differences in the plants, in order to learn how to distinguish their effects in relation to various soil factors. Eventually it may be found desirable to conduct breeding investigations for the purpose of developing special strains or varieties of plants in relation to nutritional value.

Effects of degree of maturity, age and kind of plant, rate of growth, harvesting and storage conditions and manufacturing processes on the quantity and availability of the nutritionally essential elements should be investigated.

While the effects of the various minerals, soil conditions, management practices and environmental factors upon plant growth and development are being determined, plants produced in controlled experiments or in various soil areas should be fed to the usual laboratory test animals in order to determine how their rate of development, general health and behavior are affected.

Eventually it should be possible to test the effects of plants of known composition on human beings. In the meantime, studies of the diets of various population groups, especially those dependent upon locally produced food products, with respect to the adequacy of the various mineral elements and growth substances should be enlarged.

The limited status of much of our present knowledge of mineral nutrition with both animals and plants can be explained partially by the extremely small quantities of many elements required to be effective and the lack of sufficiently refined quantitative chemical procedures. The recent development of quantitative spectrographic and polarigraphic methods adapted to the determination of minute amounts of many of these elements is removing an important limiting factor to such studies.

Now the point of this discussion of the interrelationship between soils, plants, animals and human beings can be summed up briefly so far as agricultural research is concerned. The suggestion I would like to convey is this:

There is a mass of material relating to the physiological needs of human beings. It throws new light on what we in agriculture have always known—that the soil and the plant are the primary sources of what might be called the fundamental well-being of people.

Agricultural scientists are taking cognizance of the nutritional studies in their own and related fields. Should we not intensify these efforts and through cooperation of all agencies interested in such studies make greater progress in these fields? Although the problems concerned in such investigations are extremely complex and will require considerable time and funds for their solution, still their great importance in our national life well justifies and in fact demands that such studies be made. Instead of waiting for others to conduct such studies in the future, I think we ourselves should continue to take a leading part in this field. There is need, however, for a closely coordinated scientific attack on the problems. Research on the individual phases should be coordinated and each contribution pointed to the same final objective.

Basically, what is this problem of human nutrition, which is so vital in human well-being? It is a problem of crop production, of food production. That is the most familiar of all problems to agricultural scientists. But hitherto we have thought of it too largely in terms of quantity—including factors that interfere with quantity production, like plant diseases and insects. It would be no revolutionary step for us to think in terms of *nutritional* quality as well. We have demonstrated that we have the personnel, the training, the facilities and the equipment to make some very significant contributions. We agricultural scientists have felt a strong responsibility for quantity production in the United States. Surely it is just as much our responsibility to further the production of foods of the highest *nutritional* quality—in other words, to dovetail agricultural production with human physiological needs; to move toward the ideal of a better nourished nation.

I shall not attempt here to suggest exactly where such lines of research would lead. But I am sure that one of the most fundamental steps would be a thorough study of our soils from the standpoint of their suitability or unsuitability for the production of certain foods —including the possibility of amending them, if it can and should be done, so that they will give the people who live on them, not just so many pounds of food, but all the complex and subtly balanced nutrients we human beings need. Certainly by this means, general health will be improved and there should be little if any need for adding supplements to the daily diet, except temporarily in certain cases.

It may also mean, among other things, that after thorough surveys and investigations certain soil areas may be found inefficient and undesirable for the production of food, although possibly suitable for the production of crops for certain industrial uses or for forests, parks or recreational centers. It may mean that only certain crops should be grown in certain areas or that it will be necessary to add small quantities of essential but deficient elements in a routine way through fertilizers, irrigation water or sprays to the soil or plants in some areas, so that the people dependent upon the crops in such areas will, automatically and perhaps unknowingly in most cases, have food of high *nutritional* quality. Any foods shipped from such areas would be equally valuable to consumers everywhere.

My thought can be very simply stated. Human well-being is the drive-wheel of agricultural research and this is basic to a prosperous and efficient nation. Here in this realm of nutrition we can get valuable new insights into the true meaning of our work from the standpoint of human well-being. And with new insights will come new objectives.

OBITUARY

JOHN HENRY SCHAFFNER

THE passing of Professor Schaffner from active work in the field of botany means more than the usual sadness experienced in the loss of a friend. He contributed notable papers in a prodigious number and trained a number of prominent botanists who now occupy responsible positions in several of our leading colleges and universities. There are two outstanding traits of character that all who were fortunate enough to know him have commented on—his everlastingly great patience in attempting to solve a problem or to offer explanations to questions and his ability to discover and relate in simple terms many of the problems on which his mind was constantly at work.

In a sense an era has passed with Professor Schaffner. He could be at once a pioneer in the field of cytology, in which his early observations of the reduction division in plants helped establish the firm foundation on which Mendelism now rests, and also to a striking degree a pioneer in the controversy over sex inheritance. He approached this problem in a most unbiased manner, beginning with definitions of primary and secondary sexual states. Even when many geneticists were turning toward a rather rigid Mendelian scheme of sex inheritance, he began gathering the evidence that certain restricted organisms were not safe for the purpose of basing general conclusions on sex inheritance. As a result, his papers threw the whole field open to wider experimentation and to the formulation of broader and more fundamental concepts.

His work in the field of taxonomy also pioneered in the rearrangement according to a phylogenetic system. His system proceeded from morphological studies. It, however, was confirmed in a large measure by serological studies carried out by Metz and his coworkers.

Probably the most patience-trying of his works were those dealing with the problem of sex-reversals and rejuvenation. He succeeded in obtaining four separate rejuvenations in a plant which normally dies after flowering. The spectacular success in this work did not change his habits of work nor cause him to delve as a specialist might into this field to the exclusion of all others.

This leads to the second great trait of his character. All ideas were grist for his mill, to be specifically weighed and tested. It was the simplicity with which he approached each problem that led to his solutions. His observation of minute details often led specialists in certain fields of plant identification to exclaim with surprise at his grasp of a subject. He had a marvelous memory, but his keenness of observation led to his distinguishing false and true leads with surprising facility. This was equally true in the diagnosis of plant specimens and in observation of plant behavior.

It was not surprising to find him at work on several papers at once. As he once remarked to me "When I get tired or have to wait for one thing, there is always another problem ready for me." This sublime faith in his own endeavor never flagged. It is the mark of a mind at once both great and simple.

John Henry Schaffner was born in Agosta, Marion County, Ohio, on July 8, 1866. He was educated at Baker University, Kansas; the University of Michigan, the University of Chicago and the University of Zurich, Switzerland. In 1897, when he went to Ohio State University as assistant in botany, with the late Dr. Kellerman as professor, there were fewer students in the whole university, 1,200 or less, than there are now in the department of botany each year Professor Schaffner's work on chromosome behavior between 1894 and 1898 pioneered in the field that has now developed so richly in the application of Mendelism. His papers on the prairies reflect knowledge acquired during his boyhood familiarity with plants now long gone in regions where they were native. His papers on *Equisetum* cover a whole range of plant sciences focused on the single small group of plants he loved so well to study. His eleventh paper in a series on determinate evolution is just off the press two months after his death. With reference to man, in his paper, there is this sentence, "It has been estimated, on a conservative basis, that there are over twelve billions (12,000,000,000) of cells in the human brain alone, and it is evident that the self-conscious personality, my ego, controls this amazing mechanism and other billions of cells of the body to a definite purpose while this sentence is being written." It is a remarkable sentence in that it contains one of the few personal references in his entire writings. Yet even this slight reference to himself turns out, as the context of the paragraph reveals, to be a means of stating a concept of chromosome activity. He seldom thought of himself. His vacations, always with his family, were visits to Kansas, but for the sake of his children and Mrs. Schaffner as well as for the purpose of collecting specimens they often reached Kansas by way of Maine or the Pacific Coast.

Ohio was not neglected in the matter of plant records. The catalogue of Ohio plants is as complete and the herbarium records as numerous as in any state record. Half of these have been added during the last two decades. Perhaps it was the devotion to the herbarium which brought on the heart attack, as it was evident to all of us that the climb of three flights of stairs was a severe strain. When space, more cramped of course than the herbarium, was offered in the basement with the assistants volunteering to do the errand running for changes of specimens to be studied, the answer was only a gentle No, that he preferred to be where all the stored specimens were at hand. The irony of this is that in the original plans for the building in 1914 an elevator to the herbarium was included. For lack of funds at the time this was not installed in the building.

Early in his association at Ohio State University he, with the group that numbers Professors Landacre, Herbert Osborn, Raymond Osburn, James Hine, John Bownocker, and others, founded the Biology Club. This grew into the Ohio Academy of Science. Professor Schaffner was the editor for its entire existence of the *Ohio Naturalist*, the predecessor of the *Ohio Journal of Science*. He was also editor of the *Ohio Journal of Science* from 1916 to 1918, its critical first two years. His services to the academy in this respect are unique. He was its president in 1919.

We have lost a wise counsellor and a devoted friend. We can not think of the man without his works, or the deeds without the personality that produced them. A full bibliography of his 330 papers and books will appear in another place. The Torrey Index lacks about a hundred titles of the full citation of his work. As editor, as teacher, as an example of a tireless investigator, he leaves us a rich gift in his memory.

ADOLPH WALLER

THE OHIO STATE UNIVERSITY

ARTHUR E. HILL

IT is with profound sorrow and realization of great loss that we record the death of Arthur E. Hill, who passed away on March 16, at the age of fifty-eight, at his home, 66 Clinton Place, New York City.

It has been the writer's privilege to have been associated with him over a period of thirty-nine years, during which time he has been a fellow student, a teacher and a colleague.

As a student he was always looked up to and respected by other students for his earnestness with regard to matters worth while, for his rectitude of character and with all this, his happy disposition. He graduated from the College of Arts and Pure Science of New York University in 1901. For the college year 1901–02 he held the Inman fellowship in chemistry at New York University and in 1903 was awarded the degree of doctor of philosophy at Freiburg, Germany.

Upon his return to the United States in 1904 he was appointed instructor in chemistry at his alma mater. In 1912 he succeeded Professor Arthur B. Lamb as head of the department of chemistry at New York University, which position he held until 1937.

As a lecturer and teacher he was known for his great clearness of thought and expression. Frequently, old graduates returning to the campus for a day would attend one of his lectures to receive anew the inspiration of earlier days. Although Dr. Hill was absorbed in his research the major part of his lecture work was with freshmen, and no one knows how many of these young men were inspired by his wonderful qualities as a teacher.

Aside from his superb ability as an instructor he was an indefatigable worker in his own research laboratory. Many graduate students have worked under his direction. He was not content, however, unless he too was actually carrying on research. His investigations were largely of an inorganic or physical nature, including analytical problems and the solubility relationships in binary, ternary and quaternary systems. His most important publications were with respect to the application of the phase rule to heterogeneous systems.

Although absorbed in his teaching and research he found time to serve as dean of the College of Arts and Pure Science in 1932–33 and in 1935–36.

He became a member of the American Chemical Society in 1901 and served as chairman of the New York Section, councilor of the section, chairman of the physical and inorganic section, associate editor of the *Journal* and was a member of the Chemists Club.

We, his colleagues, his students and his associates in chemistry, will miss the inspiring presence of Dr. Arthur E. Hill. His place can not, we feel, be filled as he would have filled it. We all, however, feel grateful to have known such a man, to have been associated with him and to have been helped by him. He has left us a fine example of rectitude and devotion to duty which will be a vital force for many years to come.

J. P. SIMMONS

NEW YORK UNIVERSITY

SCIENTIFIC EVENTS

THE SWEDISH STATE INSTITUTE OF NATIONAL HEALTH

IN 1936 the Swedish Government instructed certain authorities on different aspects of hygiene to study and report on the possibilities of creating a representative State Institute of National Health.

The British Medical Journal reports that the plan recommended by the authorities consulted has now been published in the form of a 78-page report supplemented by architects' drawings. It is proposed that the three main activities of the new institute shall concern (1) general hygiene, (2) occupational hygiene and (3) dietetics and food control. In each of these three main spheres the institute will conduct investigations and will serve as an adviser both to the authorities and to the general public. It must also give instruction in social welfare and medicine to doctors, nurses and health inspectors, and must also organize health propaganda. A most important activity will be the health aspects of housing. Maternity and child welfare, the care of the tuberculous, medical statistics and medical and social legislation will also be the concern of the institute. It will further deal with the injuries and ailments resulting from faulty conditions of employment. The working conditions of young people and women, working hours and the public health aspects of rationalization in industry will also be dealt with. The control of the manufacture and sale of foodstuffs will be supplemented by certain educational activities with regard to the composition of household dietaries. All these and many other activities are to be conducted in one and the same block of buildings, which will house the administrative staff, the library and the museum. The architect's plans provide for some 170 rooms. It is calculated that the buildings will cost Kr. 1,800,000, and the furnishing about Kr. 400,000. The annual cost of salaries will be Kr. 240,000, and other expenses Kr. 110,000. It is not expected that the buildings will be completed at the earliest before some time in 1940.

STUDY OF THE DISTRIBUTION OF THE FERNS AND FLOWERING PLANTS OF PENNSYLVANIA

WITH a number of institutions cooperating, a comprehensive study of the distribution of the ferns and flowering plants occurring naturally in Pennsylvania is being made in the department of botany of the University of Pennsylvania. The study involves the handling of approximately 300,000 botanical records and has been made possible by the assignment of a special technical and clerical staff from the Works Progress Administration.

Dr. John M. Fogg, Jr., assistant professor and curator of the herbarium, is directing this study. Other members of the faculty and a group of graduate students in botany are assisting in scientific aspects of the project. In addition to the University of Pennsylvania, other institutions in the state, including Pennsylvania State College, the Carnegie Museum and the University of Pittsburgh, the State Herbarium at Harrisburg and the Academy of Natural Sciences in Philadelphia are cooperating by making available all pertinent records and information.

According to Dr. Fogg, a separate card upon which is printed the entire list of sixty-seven Pennsylvania counties is being used to record detailed information concerning each one of the 3,000 or more species of ferns and flowering plants which must be covered in the survey.

Thus, if specimens of a certain plant have been collected in Wayne, Lehigh and Westmoreland Counties, that information is entered on the card under those counties. In each instance, there is recorded the exact locality where the specimen was found; the collector's name, date of collection and the institution having the specimen on deposit. Accompanying each card, which measures ten by fourteen inches, there is a second card bearing an outline map of the state with county divisions and outstanding physical features. On these maps small dots are placed to designate localities at which the specimens of a particular species have been found. The completed map therefore enables students to visualize at a glance the exact known distribution of a given species within the state and to determine the physical factors controlling its occurrence.

Only one set of maps and cards is being prepared for each species, but they are so designed as to lend themselves readily to reproduction on micro-film. Thus it will be possible to furnish to interested institutions and individuals a copy of all records made. Eventually, the entire results of the study will be published in a volume which will include not only the information on the cards and maps, but also data concerning soil conditions, climatic factors and other dynamic influences affecting distribution of the native plants.

The 300,000 specimens upon which records and information essential to the study are based are distributed approximately as follows: The Carnegie Museum and the University of Pittsburgh, 100,000; the Academy of Natural Sciences in Philadelphia, 100,000; the University of Pennsylvania, 50,000, and the State Herbarium and Pennsylvania State College, 25,000 each.

HONORARY MEMBERS OF THE HORTICULTURAL SOCIETY OF NEW YORK

THE Horticultural Society of New York, in tribute to outstanding horticulturists of the United States, has elected the following to honorary membership:

Professor Liberty Hyde Bailey, professor of horticulture at Cornell University from 1888 to 1903; dean and director of the New York State College of Agriculture from 1903 to 1913 and now emeritus professor of agriculture at Cornell.

Dr. David Fairchild, member of staff of the Bureau of Plant Industry, United States Department of Agriculture, from 1889 until his recent retirement as senior agricultural explorer.

Dr. U. P. Hedrick, until his recent retirement director for many years of the New York State Agricultural Experiment Station at Geneva. He was the recipient of the White Medal for horticultural work in 1926 and the Wilder Medal in 1930.

William Hertrich, superintendent of the Huntington Garden, San Marino, Calif.

Dr. J. Horace McFarland, leader in conservation and development of parks; president emeritus of the American Rose Society; lecturer, author, developer of Breese Hill Gardens for testing roses and other ornamental plants and recipient of George Robert White Medal of honor for horticulture.

B. Y. Morrison, principal horticulturist in charge of the division of plant exploration and introduction of the United States Bureau of Plant Industry since 1934; acting director of the National Arboretum in 1937 and since 1926 editor of the *National Horticultural Magazine*.

Professor A. P. Saunders, professor of chemistry at Hamilton College, Clinton, N. Y., since 1900, and dean of the faculty from 1909 to 1926; noted for his work in plant breeding and the promotion of horticulture.

John C. Wister, secretary of the Pennsylvania Horticultural Society for many years and director of the Arthur Hoyt Scott Foundation for Horticulture.

THE DUNDEE MEETING OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE British Association for the Advancement of Science will meet at Dundee, Scotland, from August 30 to September 5. The inaugural general meeting will take place in Caird Hall, City Square, at 8:30 P.M. on Wednesday evening, August 30, when Sir Albert Seward will deliver the presidential address on "The Western Isles through the Mists of Ages."

The preliminary program states that having in view the aims, which are among those prescribed for the association in the first statute adopted on its foundation, namely, "to obtain more general attention for the objects of science, and the removal of any disadvantages of a public kind which impede its progress," the council, in cooperation with the sections and the Division for the Social and International Relations of Science, have considered the growing strength of the public demand for a more systematic presentation of selected subjects of scientific investigation in their bearing on the life of the community. It calls special attention to this division, which was established at the Cambridge meeting in 1938 and which will hold sessions during the Dundee meeting. The following provisional program is being arranged:

Thursday, August 31. Afternoon session for papers and discussion on the coordination of scientific research on population and other topics.

Sunday, September 3. Evening meeting, open to members and the public, at which Sir Richard Gregory, Bart., chairman of the division, will deliver an address on "Science and Social Ethics."

Wednesday, September 6. Morning session devoted to discussion on nutrition.

The division is empowered to hold sessions at times and places other than those of the annual meetings of the association and arrangements are in hand for:

> A meeting in London in May for papers and discussion on certain aspects of the work of the division, including a review of its first year's work, and a meeting in Manchester during the early summer, in collaboration with the Manchester Literary and Philosophical Society, at which the Alexander Pedler Memorial Lecture will be delivered by Professor H. Levy on methods of studying the social problems of science.

Two evening lectures will be given, taking the place of the customary evening discourses:

> *Sunday, September 3.* The address by Sir Richard Gregory, Bart., on "Science and Social Ethics," announced above.
>
> *Tuesday, September 5.* Address by Dr. Isaiah Bowman, president of the Johns Hopkins University, under the arrangement concluded last year with the American Association for the Advancement of Science, by which, in alternate years, a speaker from America will be invited by the British Association, and one from Britain by the American Association.

Public lectures will be given in Dundee and neighboring towns during the period of the meeting.

Two previous meetings of the British Association have been held in Dundee, in 1867 under the presidency of the Duke of Buccleuch, and in 1912 under that of Sir Edward Sharpey Schafer. The meeting in 1912 was the occasion of a splendid act of generosity by a citizen of Dundee, the late Sir James Caird, whose gift of £11,000 to the funds of the association enabled it to commemorate his name in the Caird Fund, which is devoted to scientific research.

THE FIFTIETH ANNIVERSARY OF THE JOHNS HOPKINS HOSPITAL

THE fiftieth anniversary of the founding of the Johns Hopkins Hospital was celebrated on May 4, 5 and 6. The first exercises opened in Hurd Memorial Hall, when Dr. Winford H. Smith, superintendent of the hospital, made the welcoming address. The various programs for the reading of papers were presided over on May 4 by Dr. Edwards A. Park, Dr. Warfield T. Longcope and Dr. Nicholson J. Eastman; on May 5 by Dr. Warfield M. Firor, Dr. Thomas S. Cullen and Dr. William G. MacCallum, and on May 6 by Dr. A. C. Woods, Dr. Adolf Meyer and Dr. Eastman.

A public meeting was held in the afternoon of May 4, at which an address of welcome was made by Henry D. Harlan, president of the university's board of trustees. There were greetings to the hospital from Dr. Irvin Abell, president of the American Medical Association, conveyed by Dr. Thomas S. Cullen; greetings from Major Julia C. Stimson, U. S. A. (retired), president of the American Nurses' Association; from Dr. Fred Carter, president-elect of the American Hospital Association; from Dr. Howard Naffziger, president of the American College of Surgeons, and Dr. O. H. Perry Pepper, president of the American College of Physicians.

Dr. James B. Herrick, professor emeritus of medicine, Rush Medical College, delivered the principal address. He offered congratulations on the "glorious fifty years of service" of the Hopkins.

Later presentations to the hospital were made in the same hall, with Mr. Harlan presiding. Dr. Cullen presented a plaque in memory of Dr. Frank R. Smith; Dr. Warfield T. Longcope presented a portrait of Dr. Thomas B. Futcher, and Dr. Arthur Shipley presented a portrait of Dr. Thomas R. Boggs.

The program included the nurses' commencement exercises with an address by Miss Elsie M. Lawler, superintendent of nurses and principal of the Hopkins School of Nursing, whose address was entitled "Fifty Years in Retrospect." There were also demonstrations of the newer developments in the teaching of student nurses; a luncheon, a moving picture of Dr. Welch and of the work of the Johns Hopkins Hospital.

The anniversary banquet was held at the Emerson Hotel on the evening of May 5, with Dr. J. M. T. Finney as toastmaster. The speakers included Dr. Howard A. Kelly, Dr. Henri La Fleur, Dr. Lewellys F. Barker, Dr. William G. MacCallum and Miss Lawler.

A historical play in four scenes by Dr. Alan M. Chesney, entitled "The Flowering of an Idea," presented some of the early events in connection with the Johns Hopkins Hospital, which had an important bearing upon its subsequent development.

SCIENTIFIC NOTES AND NEWS

THE Faraday Medal of the British Institution of Electrical Engineers was presented on May 4 to Dr. William D. Coolidge, director of the Research Laboratories of the General Electric Company at Schenectady. The ceremony took place at the northeastern convention of the American Institute of Engineering at Springfield, Mass. The presentation was made by Dr. Gano Dunn, honorary secretary of the British organization in the United States.

THE George M. Kober Medal "for outstanding service in medicine" was presented at the annual meeting of the Association of American Physicians at Atlantic City to Dr. George Hoyt Whipple, dean and professor of pathology at the School of Medicine and Dentistry of the University of Rochester. Dr. Louis Hamman, of Baltimore, vice-president of the association, made the presentation.

THE Mendel Medal of Villanova College "for outstanding achievement in science" was presented on May 4 to the Rev. Dr. John M. Cooper, professor of anthropology at the Catholic University of America, Washington, D. C., in recognition of "his work on the American Indians, their social system and religion."

THE annual Howard Taylor Ricketts Prize of the University of Chicago has been awarded to George Hartley, Jr., an assistant in the Zoller Memorial Dental Clinic and a student of Dr. Paul R. Cannon in the department of pathology. The Ricketts prize was established in 1913 in honor of Dr. Howard Taylor Ricketts, who discovered the typhus germ and died a martyr to his discovery in Mexico. Awarded annually on May 3, the anniversary of his death in 1910, the prize is given to a student in the departments of pathology or bacteriology for notable research.

A DINNER attended by two hundred and twenty-five colleagues and friends was given on April 29 in New York City at the Waldorf Astoria Hotel in honor of the sixtieth birthday of Dr. Alfred E. Cohn, of the Rockefeller Institute for Medical Research. At the dinner he was presented with a volume consisting of more than three hundred congratulatory letters.

DR. ADOLF LORENZ, emeritus professor of orthopedic surgery at Vienna, celebrated his eighty-fifth birthday on April 21.

DR. PHILIPP FURTWÄNGLER, professor of mathematics and geodesy at the University of Vienna, celebrated his seventieth birthday on April 21.

DR. G. B. WEBB, of Colorado Springs, was elected president of the Association of American Physicians at the meeting at Atlantic City on May 3. Dr. Louis Hamman was elected vice-president; Dr. A. H. Gordon, of Montreal, councilor, and Dr. O. H. P. Pepper, of Philadelphia, delegate to the Congress of American Physicians and Surgeons.

AT the annual meeting in Toronto of the American Society for Experimental Pathology the following officers were elected: *President,* Ernest W. Goodpasture, Nashville; *Vice-president,* Shields Warren, Boston; *Secretary-treasurer,* Paul R. Cannon, Chicago; *Incoming Member of Council,* Balduin Lucké, Philadelphia.

PROFESSOR LOUIS P. HAMMETT, of Columbia University, was elected chairman of the New York Section of the American Chemical Society at the recent annual meeting. Dr. Robert Calvert, consulting chemist and chemical patent attorney, was named to the newly established post of chairman-elect, and William W. Winship, the present chairman of the section, becomes treasurer. Dr. Cornelia T. Snell was reelected secretary. Directors chosen in addition to the officers are Professor Ralph H. Müller, of New York University; Father Francis W. Power, of Fordham University, and Dr. Robert R. Williams, of the Bell Telephone Company.

AT the Massachusetts Institute of Technology, the title of emeritus professor has been conferred on Dean William Emerson, of the School of Architecture, and on Professor W. Spencer Hutchinson, head of the department of mining engineering. Professor Charles E. Locke has been appointed acting head of the department of mining engineering. He will succeed Professor Hutchinson upon his retirement in June.

DR. GEORGE D. BIRKHOFF, of Harvard University, has been appointed to a Walker-Ames professorship of mathematics at the University of Washington for the summer quarter.

PROFESSOR CHARLES M. DODD, of the Missouri School of Mines, has been appointed head of the department of ceramic engineering at the Iowa State College. He will succeed Professor Paul E. Cox, who will continue as professor of ceramic engineering; Dr. William G. Cochran, mathematician in the statistical department of Rothamsted Experimental Station, has been appointed professor of mathematical statistics.

DR. GUSTAV A. HEDLUND, associate professor of mathematics at Bryn Mawr College, has been appointed professor of mathematics at the University of Virginia.

DR. ROGER B. FRIEND has been appointed Connecticut state entomologist and head of the department of entomology of the Agricultural Experiment Station at New Haven. He succeeds the late Dr. W. E. Britton, who was state entomologist from 1901, when the office was established, until his death last February.

DR. CHARLES W. REES, of the zoological division of the U. S. Bureau of Animal Industry, has been appointed senior protozoologist in the National Institute of Health.

W. D. APPEL, chief of the textile section of the National Bureau of Standards, has been appointed acting chairman of the research council of the U. S. Institute for Textile Research, and Edward R. Schwarz, professor of textile engineering of the Massachusetts Institute of Technology, has been made vice-chairman. They succeed, respectively, W. E. Emley, chief of the Organic and Fibrous Materials Division of the National Bureau of Standards, and

Dr. H. DeW. Smith, treasurer of the A. M. Tenney Associates.

DR. J. M. STAGG has been appointed superintendent of Kew Observatory, England, in succession to Dr. F. J. W. Whipple, who retired on March 31.

DR. E. W. R. STEACIE, associate professor of chemistry at McGill University, has been appointed director of the Division of Chemistry of the National Research Council of Canada, in succession to Dr. G. S. Whitby, who recently resigned to accept the post of director of Chemical Laboratories of the Department of Scientific and Industrial Research in Great Britain. It is expected that Dr. Steacie will assume his new work early in July.

DR. ALEXANDER LURIA, head of the department of psychology of the Medico-Genetic Institute of Moscow, has been elected Salmon Memorial Lecturer of the New York Academy of Medicine for 1940. On April 12, 19 and 26 he spoke on "The Psychological Approach to Brain Pathology." He will give a fourth lecture at a city to be selected later.

DR. ALBERT SZENT-GYÖRGYI, professor of medical chemistry at the University of Szeged, Hungary, will deliver the eighth Harvey Society lecture of the current series at the New York Academy of Medicine on May 18. He will speak on "Biological Oxidation and Vitamins." On May 26 he will speak before the Institute of Medicine of Chicago, where his lecture will be entitled "The Mechanism of Biological Oxidation."

DR. CHARLES F. POE, professor of chemistry at the University of Colorado, gave the principal address at the recent installation of the Utah Alpha Chapter of Alpha Epsilon Delta, national honorary premedical fraternity, at the Utah State Agricultural College and at the installation of the Wyoming Alpha Chapter at the University of Wyoming.

DR. DOUGLAS JOHNSON, professor of physiography at Columbia University, addressed the faculty and students of Vassar College on April 14 on the "Geologic Basis of Landscapes—a Study in the Conservation and Utilization of Scenery." On March 30 he gave the convocation address at the University of West Virginia, on the occasion of the installation of a new chapter of Sigma Xi, where he discussed "The Mysterious Craters of the Carolina Coast."

DR. NEVIN M. FENNEMAN, professor of geology at the University of Cincinnati, gave a series of lectures to the faculty and students of the department of geology at the University of Kansas during the week of April 17. The lectures were arranged on an exchange basis with the department of geology at the University of Cincinnati. Dr. Kenneth K. Landes will give a similar series of lectures in Cincinnati next autumn.

DR. K. LINDERSTRØM-LANG, director of the chemical division of the Carlsberg Laboratory, Copenhagen, on March 27 addressed a joint meeting of the Duke University Hospital Medical Society and the Duke University Chapter of Sigma Xi on "Recent Histochemical Studies on Enzymes." On April 17, Dr. E. Fullerton Cook, chairman of the U. S. Pharmacopeia Revision Committee, lectured on "The Physician and the Pharmacopeia."

DR. J. A. BECKER, of the technical staff of the Bell Telephone Laboratories, has completed a tour of the Midwest, at which time he presented a lecture on "Electron Microscopes and Some of Their Uses" to groups at the Chicago Physics Club, the State University of Iowa, the Iowa State College, the University of Kansas, the Kansas State College, the University of Missouri, Washington University and the Ohio State University. Dr. Becker demonstrated one type of microscope having a magnification of 500,000.

THE Rutherford Memorial Lecture of the Royal Institution, London, was given early in April by Sir Henry Tizard. The lecture was entitled "Lord Rutherford, His Life and Influence on Chemistry."

THE six hundredth anniversary celebration of the University of Grenoble will be held from May 13 to 15.

THE international committee has voted to hold the next meeting of the International Congress of Psychology at Edinburgh in the summer of 1940.

THE annual meeting of the Field Conference of Pennsylvania Geologists will be held at Morgantown, W. Va., at the invitation of the West Virginia Geological Survey, from May 27 to 30. Those interested are requested to address Dr. Paul H. Price, state geologist, Morgantown, or M. N. Shaffner, secretary-treasurer, care of Pennsylvania Topographic and Geologic Survey, Harrisburg.

THE Association of Southeastern Biologists held its third annual meeting at Duke University on April 14 and 15. Thirty-three papers in the fields of zoology and botany were presented. The guest lecture was given by Dr. Harden Taylor, president of Atlantic Coast Fisheries Company, who spoke on "Biology and the Great Fisheries." There were a hundred biologists from seven southeastern states in attendance. The following officers were elected: *President,* Dr. H. L. Blomquist, Duke University; *Vice-president,* Dr. J. Speed Rogers, University of Florida; *Secretary-treasurer,* Dr. Donald C. Boughton, University of Georgia, and *Members of the executive committee,* Dr. R. O. Christenson, Alabama Polytechnic Institute, and Dr. E. E. Reinke, Vanderbilt University.

THE New York State Association of Applied Psychologists met at Cornell University on April 29, with seventy members in attendance. Symposia were devoted to "The Training of Psychological Counselors" and "The Work of the School Psychologist." Addresses were given by Dr. F. H. Allport on "Methods of Personality Study"; by Dr. Ethel Waring on "Generalizing Abilities of Preschool Children"; and by Dr. W. V. Bingham, president of the association, on "Vocational Guidance in New York State." Fordham University was selected as the place of the next annual meeting.

THE Royal Society, London, is preparing for the Ministry of Labor a register of scientific research workers whose services could be used for the nation in the event of war. Professor Archibald V. Hill, Foulerton research professor and joint honorary secretary, is chairman of a subcommittee for scientific research attached to the Central Register Advisory Council of the Ministry of Labor. Sir Walter Moberley, chairman of the Advisory Council, is reported to have stated that "The general scheme includes the registration of technicians, engineers, architects, and others. This work is being dealt with by their appropriate professional institutions. So far as the scientists are concerned, we felt that the Royal Society was the natural body to undertake the work and that Professor Hill, as one of its secretaries, was the right man to act as chairman."

THE spring meeting of the Indiana Academy of Science was held on May 12 and 13 at New Harmony, which was an early center of science in the West, being the home at one time of William Maclure, Charles Alexander LeSueur, Thomas Say, David Dale Owen, Robert Dale Owen and Richard Owen, and being visited once by Sir Charles Lyell. The program was devoted in part to lectures on the early scientific history of New Harmony as well as to the more recent studies in the geology, flora and fauna of the area. There were also conducted tours among the sites of historic and scientific interest.

THE twenty-eighth annual report of the Brooklyn Botanic Garden for the year 1938 records a total attendance for the year of more than 1,628,000, with a record week-end attendance from noon, April 30, to 5 P.M., Sunday, May 1, of 56,145, or at the rate of about 155 every two minutes. Two new gates were constructed during the year, financed by a bequest of $10,000, and a beautiful memorial approach, consisting of stone seats, water basins, fountain and monumental columns, just inside the main entrance, was made possible by a gift of $32,000. Private funds contributed, in addition to income from endowment, were in excess of $54,000. About 56 per cent. of the total maintenance budget was met from private funds, and about 43 per cent. from the tax budget of New York City. A new garden of medicinal and culinary herbs was opened to the public in September. About twenty pages of the report are devoted to summaries of the research work in progress during the year.

DISCUSSION

WILL IODINE COME TO BE CONSIDERED AN ESSENTIAL PLANT NUTRIENT?

INFLUENCE of iodine has been studied in water and soil cultures at Oregon Agricultural Experiment Station beginning in 1929. Crop indicators used in experiments include alfalfa, clover, peas, corn, lettuce, tomatoes and sunflowers.

Mathematically significant increases in yield have been obtained, especially with alfalfa, clover and lettuce, while germination has been stimulated with corn. Iodine seems to promote development of chlorophyll or green pigment in plants. Soil micro-organisms appear to be affected, particularly nitrogen-fixing legume root bacteria. Yeasts are known to be stimulated by iodine.

Favorable concentration in flowing culture solutions is found to be one fourth to one half part per million. Flowing solutions were connected in series by Waldo Carlson, graduate assistant, who found the age of solutions affected stimulation and older solutions were more beneficial. The iodine may change to organic form before it is effective. With alfalfa in "sterile" culture this concentration was inhibitive, an indirect effect is indicated. James C. Lewis, graduate assistant, found stimulation from iodine in soil cultures using a soil well supplied as to total iodine. Two to four pounds of iodine as potassium iodide were found to be significantly stimulating in soil cultures with Aiken and Deschutes soil series. Other soils have given negative results. Even where increase in yield was small the iodine content of the plants has been increased manyfold according to analyses by Mr. Lewis.

Comparison of methods for iodine determination has been made in the laboratory of Dr. J. R. Haag, nutrition chemist. Some improvement has been made in adapting the Harvey procedure for analysis of soils and plant materials.

Oregon soils, waters and plants are frequently low in iodine, yet certain deep wells, lakes and soils are found to be well supplied. Iodine in Oregon soils may run from ½ part to 15 parts per million. The iodine content of Oregon waters is from .01 to 20 parts per million. The relation seems sharpest between iodine content of water and goiter. Soil iodine seems to accumulate some with organic matter and to be higher in soils of sea-bed origin. Baumann in 1895 found absence of iodine in plants affects thyroid. Aso in 1903 recommended seaweed as fertilizer, due to its iodine content.

According to a map of the United States prepared by Dr. J. F. McClendon there is a high incidence of goiter in certain areas, including much of the Pacific Northwest. Head lettuce and spinach are among the plants that contain relatively more iodine. Marine by-product fertilizers afford a source of iodine. Small-scale field trials are being made this season. If successful, potassium iodide might be added in irrigation water or large seed may absorb sufficient amounts for plant needs.

W. L. POWERS
OREGON STATE AGRICULTURAL COLLEGE

RANGE PLANT NEWLY FOUND TO BE POISONOUS

WHILE searching for the cause of death of cattle in a small herd in northeastern Colorado, several native plants suspected of causing poisoning were fed. One of these plants, *Picradeniopsis oppositifolia* (Nutt.) Rydb. or *Bahia oppositifolia* A. Gray, was found to have poisonous properties, though hitherto unsuspected. The plant is a low-growing, gray-green perennial three to six inches tall with opposite, three to five divided leaves. It belongs to the thistle family and has small tight heads of yellow flowers.

Feeding experiments were conducted to determine its actual toxicity for cattle and sheep. Approximately six quarts of the finely ground plant was force-fed to a 650-pound steer by means of a stomach tube. Typical symptoms of HCN poisoning were produced, starting in about 30 minutes. Although the animal showed the accelerated respiration, trembling and muscular incoordination which are characteristic in HCN poisoning, these symptoms lasted for only about 30 minutes. Following this, although the animal had apparently recovered from the effects of the HCN, a marked depression was observed, which endured for more than three hours, but the eventual recovery was complete. Identical results were obtained when fed to guinea pigs.

A mature ewe was also force-fed, using 1½ quarts of the chopped-up plant. The chain of symptoms was very similar to those produced in the steer, but more severe. Again a period of depression was followed by complete recovery.

Bahia oppositifolia is not readily eaten by stock except when forage is scarce, and it is questionable if they ever eat enough to prove injurious.

However, since quantitative chemical analyses of the plant indicate an average HCN content of .03 per cent. it may be considered potentially dangerous to live stock.

A. W. DEEM
FRANK THORP, JR.
L. W. DURRELL
COLORADO AGRICULTURAL EXPERIMENT
STATION

THE TRANSPORT OF WATER TO ANODE OR CATHODE THROUGH NON-AQUEOUS LIQUIDS

EXPERIMENTS have been reported recently by W. J. V. Osterhout and J. W. Murray in the May 13, 1938, issue of SCIENCE, page 430, and by H. E. Bent in the December 2, 1938, issue of SCIENCE, page 525, concerning the "Movement of Water from Concentrated to Dilute Solutions through Liquid Membranes."

The author has conducted experiments with non-aqueous liquid membranes, separating two equal portions of the same salt solution in water and has found that in some cases water is transported to the cathode solution, while in other cases water is transported to the anode solution, when platinum electrodes are dipped in the two salt solutions and connected to a source of direct current of 110 volts or more. With 110 volts the transport of water through an intervening membrane of benzaldehyde or of carbon tetrachloride is very slow, requiring several days or weeks before showing an appreciable change in the two volumes of aqueous solution. At voltages around 450 to 500 the transport of water is much more rapid, and a considerable difference in the two volumes may be observed within two days.

The apparatus in each experiment consisted of a U-tube with benzaldehyde or carbon tetrachloride filling the curved part of the tube with an equal volume of the saturated aqueous solution of the salt introduced into each arm of the tube above the liquid membrane simultaneously and carefully so that the solution would lie on top of the liquid membrane, with platinum wire electrodes dipping into the aqueous solutions and connecting to the direct current source, at first a 110 volt d.c. supply line, later a transformer-vacuum tube rectifier, which would furnish up to 500 volts and was designed to produce continuously up to 100 milliamperes. Much lower currents than this passed through the solutions separated by the liquid membranes.

When the electrolyte was ammonium oxalate, water was transported to the cathode side through benzaldehyde or through carbon tetrachloride. Likewise, when the electrolyte was sodium oxalate, water was transported to the cathode through benzaldehyde or through carbon tetrachloride. When the electrolyte was cupric nitrate, water was transported to the anode side through benzaldehyde and through carbon tetrachloride. These phenomena I have interpreted as indicating that the ammonium ions and sodium ions are hydrated to a greater extent than the oxalate ions and that the nitrate ions are hydrated to a greater extent than the cupric ions; that the transport of water is due to this greater hydration of the ammonium and sodium cations of the oxalates, thus causing transport of water to the cathode side, and to the greater hydration of the nitrate anion, thus causing transport of water to the anode side in the cupric nitrate experiments.

There are two possible paths by which the water may be transported. The hydrated ions may actually move through the body of the intervening liquid membrane or they may pass along the outer edge of the liquid between the liquid and the glass wall. The liquid membrane takes on a cloudy appearance both with the benzaldehyde and the carbon tetrachloride; but this might occur in either type of movement of the hydrated ions. In any event, by whatever path the ions are transported, there results an increase of acid in the anode side and an increase of base in the cathode side, indicating that the transport of water is accompanied by the transport of the cations to the cathode side and anions to the anode side of the liquid membrane, that it is not a simple case of electroendosmosis of the water but rather the movement of hydrated ions. Another point that would seem to rule out the idea of electroendosmosis is that in the experiments with ammonium oxalate in water over benzaldehyde, deposits of benzaldehyde were detected on the cathode, even though it had never been in direct contact with the benzaldehyde. No such deposit of benzaldehyde was found on the anode. This seems to indicate that the benzaldehyde bears a positive charge and tends to move toward the cathode. In electroendosmosis the water moves in a direction opposite to the direction in which a colloidal membrane tends to move. Therefore, water would be expected to move toward the anode if it moved essentially by electroendosmosis; whereas, water was actually transported to the cathode side in this experiment.

Preliminary quantitative determinations of the amounts of ammonium ion, oxalate ion and water transported indicate that in electrolyzing ammonium oxalate through benzaldehyde two oxalate ions migrate, while one ammonium ion migrates. This would seem to indicate a rather high degree of hydration of the ammonium ion producing a large, heavy, slow-moving ion. Though it appears rather high, preliminary determinations of the number of water molecules transported for each ammonium ion transported give a value of 892.

Other experiments of a similar nature are being conducted by the author in the hope that it may become possible to measure directly the degrees of hydration of the various ions, a subject of great importance to all who work with aqueous solutions.

CHARLES C. RAINEY

UNIVERSITY OF TENNESSEE MEDICAL SCHOOL

PROPOSING THE TERM, PREDATEE

FOR those working in ecology or fields of animal control there has developed a need for a term to designate animals preyed-upon, corresponding to "predator" for those which do the preying. The word "predatee" would be the logical one, and we propose it for the purpose.

The word predator has only comparatively recently been included in the dictionaries. It of course appeared as an answer to the need for a noun growing out of the word predatory. Now, as an outgrowth of ecological studies requiring an expression of both sides of this food relationship among animals, there comes the need for the other word, namely, predatee. Like the terms, employer and employee, the two terms are necessary to each other. One can not very well exist without the other. They express complementary parts of a single concept. Hence this proposal for recognition of the word.

L. D. WOOSTER

FORT HAYS KANSAS STATE COLLEGE

SOCIETIES AND MEETINGS

THE AMERICAN PHILOSOPHICAL SOCIETY

THE annual general meeting of the American Philosophical Society was held on April 20, 21 and 22 in its Hall on Independence Square, where its meetings have been held for almost one hundred and fifty years, for it was on November 13, 1789, that the society first met in the then newly finished building which has ever since been its home. The meeting this year was attended by about 200 members and invited guests, while approximately twice that number were present at the Penrose Memorial Lecture on Friday evening, which was given by Dr. Eduard Benes, formerly president of Czecho-Slovakia, who spoke in a notably calm and scholarly manner on "Politics as Science and Art." Thirty-five papers were presented in four half-day sessions; two of these papers were in mathematics, two in astronomy, six in physics, two in geology, six in botany and genetics, four in zoology and physiology, three in anthropology, three in modern history, three in ancient history and archeology, two in philology and literature and one in music. Several of these overlapped two or more fields and are therefore hard to classify.

The fact that the membership of the society includes all these fields of learning, as well as several others, tends to make the presentation of papers less technical and more generally intelligible than is the case in the meetings of more highly specialized societies. This is one of the peculiar charms of these general meetings which is frequently commented on. At an open forum discussion of the activities of the society which was held on Saturday afternoon, many members said they enjoyed most the papers in fields other than their own, while those who present papers find it profitable and stimulating to attempt to make plain to scholars in other fields the results of their special studies. Some technical societies are at present lamenting the fact that their meetings have become so highly specialized that their programs are uninteresting or unintelligible to many of their own members and they are calling for papers of more general interest. Important discoveries can usually be presented in a manner that is intelligible to scholars in other fields, and if this can not be done they are not suitable for public presentation. Lord Kelvin is reported to have said on one occasion: "That physicist, who, having completed a research no matter how attenuated, on reaching the street can not explain his finding and its usefulness to the first man he meets, should return to his laboratory; his research is not complete."

It is probably true that general societies with nontechnical programs do not notably increase knowledge in special subjects, but this is not their function. They do render an important service in stimulating wider interests and in promoting helpful associations among scholars in different fields. A society is first of all a social organization and not a library or laboratory. Information may be obtained in printed form, but nothing can be substituted for the social contacts which are promoted by such meetings.

The hospitality of Philadelphia to learned societies is proverbial, and this makes meetings in the Quaker City most enjoyable. Several years ago, when an international scientific congress was held in this country and was being entertained in various cities the general secretary of the congress telegraphed to the Washington committee asking what entertainment would be provided there. They replied that Washington would do whatever Philadelphia did. The general secretary telegraphed, "Philadelphia meets all hotel and other expenses." At once came back the answer, "Not on your life will we follow Philadelphia." The hospitality of the American Philosophical Society is probably unique among learned societies in this country; its luncheons, receptions and annual dinners are justly famous. But these are not merely gastronomic events but, much more, delightful occasions for social intercourse and scientific conferences. In addition to these general entertainments, the annual dinner given to the council of the society by one of its Philadelphia members is an event which no councillor would ever willingly miss. During the meetings all out-of-town members of the society and their wives as well as other persons who are invited to read papers are the guests of the society at a leading hotel. Undoubtedly this hospitality gives an air of friendliness to the meetings which is most delightful.

The annual business session was held on Friday morning, April 21. The president, Roland S. Morris, in his annual report stated that the invested funds of the society now amount to more than $7,000,000, with an annual income of approximately $200,000 available for general purposes. The budget allots about one half of this sum for grants-in-aid of research, $38,000 for the library, $25,000 for the publications of the society, $6,000 for the expenses of the meetings, about $10,000 for the executive office, $6,000 for the treasurer's office, $4,000 for the maintenance of the building, $6,000 for repairs and about $10,000 for miscellaneous expenses.

The committee on finance, consisting of eight of the leading financiers of Philadelphia who are devoted members of the society, meets regularly once a month and gives constant attention to the finances of the society. The committee on research, publications and library meet five times a year and devote much thought and care to these activities of the society. All committee members serve without personal compensation beyond actual expenses in attending meetings.

On Saturday afternoon, April 22, an open forum of the members for the discussion of the four principal activities of the society was held, and valuable suggestions were made for the improvement of the meetings, the library, the support of research and of publications.

The closing event of the meeting was the annual dinner, at which about 200 persons were present. The John F. Lewis Prize of $300 and diploma for an important contribution made at a stated meeting of the society, was awarded to Professor Henry Norris Russell for his lecture on February 17, 1939, on "Stellar Energy." The citation was made by Professor Harlow Shapley in an unusually happy and instructive speech and was responded to by Professor Russell. Other after-dinner speakers were Victor G. Heiser on his experiences on International Health Board, Jesse S. Reeves on "Neutrality," and Vannevar Bush on "Research and National Defense."

EDWIN G. CONKLIN

THE NATIONAL ACADEMY OF SCIENCES

ABSTRACTS OF PAPERS READ AT THE ANNUAL MEETING

(Continued)

Auto-equivalent functions: GEORGE D. BIRKHOFF. An analytic function $f(z)$ of a single complex variable z is called auto-equivalent if there exists a one-to-one analytic deformation $\bar{z} = \varphi\ (z)$ of the neighborhood of $z = \infty$ which modifies $f(z)$ only by a factor $a(z)$ analytic or with a pole at $z = \infty : f(\varphi(z)) = a(z) f(z)$. The class of auto-equivalent functions, together with its natural extension to matrices, includes an extraordinary variety of functions having fundamental importance in analysis.

Professor Birkhoff outlines his general theory of these functions, which will appear shortly in the *Annales de l'Institut Henri Poincaré.*

Minimal surfaces of general critical type: MARSTON MORSE and C. B. TOMPKINS. Many fundamental theorems in analysis depend upon the existence of a minimum of a function. The calculus of variations extends this theory to functionals. To obtain the point of minimum it is sufficient that the function be bounded below, be lower semi-continuous and the space in which the function is defined be compact. If one seeks all the critical points or configurations in a given problem, for example, the minimal surfaces bounded by a simple closed curve with continuously turning tangent, there are many critical configurations which fail to disclose themselves upon use of the minimum methods. The authors' recent fascicle (Paris) "Functional Topology and Abstract Variational Theory," lays down general principles which can serve to replace the classical minimum principles in general problems. The present paper shows that these general principles can be applied to the theory of minimal surfaces, with proofs of the existence of minimal surfaces without minimum area resulting. This is the first example of an application of the authors' general theory of critical points to multiple integrals and seems to open up a vast new field.

Infra-red absorption of hydrogen fluoride: W. H. RODEBUSH.

Electrophoretic studies on blood sera: DUNCAN A. MACINNES and LEWIS G. LONGSWORTH. The "electrophoretic diagrams" of blood sera have been obtained by a modification of the Tiselius method, in which the gradients of refractive index in the electrophoretic boundaries are automatically recorded. These electrophoretic diagrams indicate the number, the mobilities, the amounts and the relative homogeneities of the proteins present. The diagrams of the sera of normal animals have been found to be characteristic and entirely reproducible. The diagrams for pathological sera show, however, abnormalities, the interpretation of which is only begun. Particularly interesting diagrams are obtained from the proteins of nephrotic serum and urine. Although the distribution of proteins in the nephrotic serum is decidedly abnormal the electrophoretic diagram of nephrotic urine is, very closely, that of normal *serum.*

Responses to different levels of nutritional intake of riboflavin (formerly called vitamin G): H. C. SHERMAN and L. N. ELLIS. It is found in the case of riboflavin (as has also been found with calcium and with vitamin A) that there is a wide zone between the level of merely *adequate* (minimal-adequate) intake and the *optimal* level—that which gives best results in nutritional well-being and resultant health and vitality in long-continued experiments. In the first generation the plateau of externally demonstrable nutritional well-being is attained with intakes about three times higher than the minimal-adequate which supports normal growth and health with successful reproduction and rearing of vigorous offspring. In these offspring there are detectable successive gains in nutritional welfare with successively increased riboflavin value of the family dietary up to at least seven to ten times the minimum adequate riboflavin content of the food mixture. These further gains are, as yet, shown chiefly through increased capacity for growth both on their respective family dietaries and on a riboflavin-deficient diet. The findings are discussed in terms of body storage of riboflavin and of the influence of the level of intake of this substance upon the body's internal environment or general tissue condition.

Experimental results supporting the "fluid flow" theory of the biological action of ionizing radiations: G. FAILLA and K. SUGIURA (introduced by Harold C. Urey). In 1937 one of us[1] proposed a theory of the biological action of ionizing radiations, relating particularly to effects produced in living tissues when only a part of the animal's body is irradiated. According to this theory it should be possible to increase the radiosensitivity of a tissue by increasing its circulation and particularly by injecting (sterile) distilled water into it at different intervals subsequent to irradiation. An experiment to test this point has been carried out during the last six months, using animal tumors as the test tissue. The results are shown in Table 1. These results were obtained by injecting into the tumor 0.5 cc of sterile distilled water a few times a day during the first three or four days following local irradiation of the tumor with x-rays. Similar injections of distilled water into non-irradiated tumors do not cause regressions. Irrespective of any theoretical considerations it is evident that the radiosensitivity of Sarcoma 180 may be increased markedly by injections of distilled water following local treatment with x-rays.

TABLE 1

EFFECT OF X-RAYS AND DISTILLED WATER ON THE GROWTH OF MOUSE SARCOMA 180 IN VIVO

X-ray dose in Roentgens	Per cent. tumor regressions	
	X-rays alone	X-rays + H_2O
500	2	30
750	13	60
1000	50	100
1800	100	100

Degrees of sterility in the female rat held on E-free rations: HERBERT M. EVANS and GLADYS A. EMERSON. It is well known that 500 mg of wheat germ oil or 3 mg of α-tocopherol will enable young mature rat females which have been reared and held on an E-free diet to give birth to normal-sized litters of living young. This curative dose of vitamin E is inadequate shortly after the eighth month of life, but a double or treble dose will act curatively. At the close of the first year of life the birth of living young can still be provoked by the administration of eight to ten times the original minimal effective dose. Older females conceive and implant, but the young can not be rescued by any practicable dose level of vitamin

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[1] G. Failla, "Some Fundamental Aspects of the Cancer Problem." Supplement to SCIENCE, Vol. 85, 1937.

E. The cause of what appears to be increasing need for E on the part of the embryos is entirely obscure.

The relief of symptoms in major trigeminal neuralgia (tic douloureux) following the administration of massive doses of vitamin B_1 supplemented in some instances by concentrated liver extract: H. BORSOOK, M. Y. KREMERS and C. G. WIGGINS (introduced by T. H. Morgan and Max Mason). Major trigeminal neuralgia (tic douloureux), a disease of man, offers the following advantages for the study of the physiology of pain and of the chemical physiology of the nervous system. The disease in most cases (96 per cent.) is unilateral, and is restricted to the sensory distribution of the trigeminal nerve. The main symptom is intense facial pain. The effect of parenteral administration of large doses of vitamin B_1 in relieving the pain in this disease has been studied. The vitamin B_1 was given by intravenous injection in doses which varied from 10 mg to 100 mg. This was given every day six days a week. A well-balanced diet was supplemented by a daily intake by mouth of one ounce of an aqueous concentrate of the vitamin B complex containing 1,500 I. U. of vitamin B_1; and of a fish liver oil containing 9,000 vitamin A units (U. S. P. X1) and 1,700 vitamin D units (U. S. P. X1). No analgesics were used. Measurements have been made of the chronaxie and the sensory thresholds of the pain spots in the affected parts of the face and compared with the corresponding points on the opposite side of the face. No difference was observed between the two sides. Eleven cases have been under observation for eleven months; forty-five cases for six months. Of the cases observed for eleven months seven became practically symptom free in three months after treatment was begun and have remained so since without further injection of vitamin B_1. Two improved to a lesser degree. One showed no improvement. Essentially the same results were observed in the other forty-five cases under observation now for six months. In ten cases in which there was no improvement or incomplete recovery following the administration of vitamin B_1 in large doses for three to four months, there has been marked improvement when, in addition to the vitamin B_1, large doses of concentrated liver extracts were injected intra-muscularly every other day. A crude preparation containing one anti-pernicious anemia unit per cc but rich in other constituents of the liver was less effective than a more concentrated preparation which contained fifteen units per cc of the anti-pernicious anemia principle but less of other materials extractable from liver. No cases have yet been treated with liver extract alone. There are among the cases showing marked improvement a number over seventy years old who have had the disease in some instances for more than twenty years.

A law of denervation: WALTER B. CANNON. When nerves which deliver impulses to smooth muscle, skeletal muscle and glands are severed and allowed to degenerate the denervated structures become specially sensitized to excitant or depressant drugs. Nerve cells which receive impulses from other nerve cells may be regarded as being innervated by them. Section of fibers which convey impulses to the nerve cells of a ganglion, for example, renders these cells more sensitive to chemical stimulation. Partial denervation has a similar effect. Likewise, when nerve cells in the spinal cord are partially deprived of the connecting fibers which normally influence them, the "denervated" cells become more readily excitable by chemical agents or by a chemical change in the blood.

The chemical composition of the gaseous nebulae: I. S. BOWEN and A. B. WYSE. The lines hitherto observed in the spectra of the "gaseous" nebulae are for the most part attributable to gaseous elements, such as hydrogen, helium, nitrogen, oxygen, etc. Many of the lines are known as "forbidden lines," since they are not ordinarily observed in the laboratory; in the conditions of extremely low density obtaining in the gaseous nebulae, however, the "forbidden lines" are frequently stronger than the so-called "permitted" or ordinary laboratory lines. We have recently made long-exposure photographs of the spectra of three of the brightest planetary nebulae. In one or more of these objects, more than fifty new lines have been observed, of which nearly one half have been identified. In addition to the gases and a few other elements already known to be present, we find evidence for the existence in the nebulae of silicon and of the metallic elements, magnesium, potassium, calcium and iron. The relative abundance of the various elements in a planetary nebula can be roughly calculated from the intensities of the spectral lines, if the physical conditions of the nebula are taken into account. Such a calculation has been made for one of the nebulae observed, NGC 7027, which happens to be especially suitable for the purpose. (As far as present observations go, there is no reason to doubt that NGC 7027 in its chemical composition is typical of the "gaseous" nebulae in general.) Russell has already determined, in a somewhat analogous manner, the relative abundance of the chemical elements in the sun's atmosphere. In spite of the extreme difference in appearance between the spectrum of NGC 7027 and that of the sun's atmosphere, we find no evidence for any difference in chemical composition between the two objects. When an element is observed in the one object and not in the other, the apparent difference is attributable to differences in physical conditions, such as temperature and density, rather than to differences in chemical composition.

Determination of a stellar darkening coefficient from observations of an eclipsing variable: GERALD E. KRON (introduced by W. H. Wright). It is known, from observation of the sun and the implication of simple theory, that stellar disks are dimmer near their edges than at their centers. The amount of this "darkening at the limb" is an important physical constant; observation of its dependence upon temperature and color would aid theory, and make possible more accurate determination of fundamental physical constants of stars. The eclipsing variables, double stars partially or wholly covering each other during orbital revolution, offer the only known means of observing limb darkening. The way in which the light varies as an eclipse progresses will depend upon the degree of uniformity of illumination of the stellar disks. The shape of the "light curve" is affected also by other physical constants of the system. These additional constants as well must be determined from the light curve. Altogether the problem is so complex as to make strong demands upon the data of observation. and the precision of photometric measurement has heretofore been insufficient to permit disentangling the effects of darkening from other somewhat similar ones due to other causes. A photoelectric photometer was recently constructed for use with the 36-inch refractor of the Lick Observatory. It employs a Kunz potassium hydride photocell sensitive to deep blue light, operating in the circuit of a direct current amplifier. Good observing conditions, the comparatively large size of the telescope and the use of a special optical device that permits the almost instantaneous comparison of two stars have made it possible to obtain unusually accurate photometric observations. The eclipsing variable YZ (21) Cassiopeiae was observed with this instrument. A complete light curve with two minima defined by 54 normal points having probable errors of ± 0.0011 magnitude was obtained. Approximate values were assumed for six physical constants of the stellar system, namely, the darkening coefficients and radii of each star and the orbital inclination and eccentricity. Corrections to these elements have been derived by a method of "least squares" adjustment newly developed by A. B. Wyse. The derived value of the darkening coefficient is 0.502 ± .037. The relatively small ratio of the probable error to the total possible range of the quantity itself (4 per cent.) is an indication of the close accordance of observation and theory, and is regarded as justifying the analytical procedure employed.

Solar variation and weather: C. G. ABBOT. Author presents a diagram showing the average march of departures from normal temperature at Washington for 16 days following 320 occasions of rise or fall of the sun's radiation as measured at Montezuma, Chile. Data were separated into 12 groups, one for each month of the year, for the average march of departures differed from month to month. Well-marked opposition of the curves is shown following, respectively, rise and fall of the sun's radiation. Large solar changes are followed by large temperature departures. Results of the first 6 years agree closely with results of the last 6 years covered. To clinch the demonstration, author computes the march of temperature departures similarly for 16 days preceding the dates of solar change. He correlates the results preceding and following those dates. Prior to solar changes the correlation coefficient between rising and falling cases is + 11 ± 6 per cent., which is meaningless. Following solar change the correlation is − 54 ± 5 per cent., eleven times its probable error and therefore significant. The separation of temperature departures following rise and fall of solar radiation frequently exceeds 10° and sometimes even 20° F., though the average solar change is but 0.7 per cent. Solar variation, therefore, appears to be a major influence in weather, and if solar constant values accurate to ⅛ per cent. could be obtained daily they would seem to afford means of predicting details of weather for two weeks in advance.

Geologic growth of Asia: BAILEY WILLIS. Among the generally accepted traditions of geology is the assumption that continents are ancient features of the earth's crust, with essentially their actual form, and that they originated in some primeval stage of cooling or crustal formation. It has long been known that they consist chiefly of granite, which has been uptruded from within the globe, and it is now established that the molten granitic bodies spread out in the form of thin discs in the outer crust. While perhaps several hundred kilometers in diameter, any such disc is usually not over 30 kilometers thick, and the underlying rock is commonly basalt. It is recognized that each one of the great continents is made up of a number of such discs of granite, between which the granitic layer may be relatively thin or be represented by smaller intrusions, or be lacking altogether. Thus the concept that a continent is a vast expanse of primeval granite is replaced by the fact that each continent is a mosaic of comparatively small nuclei, which may be more or less closely contiguous or widely separated. Furthermore, it is established by the relations of the intruded granite to fossiliferous strata or by radio-active analyses of the granites themselves that the intrusions differ greatly in age. Some are as much as one or two billion years old; others reached the outer crust as recently as sixty to thirty million years ago. The younger eruptions have tended to rise around the older bodies or between them and they thus fill in the interspaces. The process constitutes continental growth. It has been in progress since the earliest ages of geologic history and presumably is still active. In this paper the known granitic nuclei of Asia are enumerated, according to the data contributed by British, Russian, Chinese, Japanese and American geologists, and it is shown that continental Asia has grown from a few widely separated nuclei of Archean age to the actual expanse by successive uptrusions of granite, very important additions having been made during the Mesozoic era and some even as lately as in Tertiary time. The conclusions have critical bearing upon theories of continental permanence, continental drift and paleogeography.

A hypothesis of submarine canyon origin: DOUGLAS JOHNSON. The origin of submarine canyons of great depth cut far back into the margins of the continental shelves has been debated for more than fifty years. No wholly satisfactory solution of the problem has as yet been found. The following working hypothesis is offered for consideration: Water expelled from consolidating sediments and water under artesian pressure moving through the sediments may find exit in the form of submarine springs on the deeply submerged seaward face of the continental shelf. Spring sapping on land is known to have produced canyons in a relatively brief interval of time. Spring sapping along the shelf margin continuing throughout long periods of geologic time could conceivably produce the results observed. Past geological conditions are believed to have favored this method of origin. Acceptance of the hypothesis would dispose of most of the difficulties confronting other explanations of submarine canyon development. The explanation at present most popular, that the canyons are normal river valleys deeply submerged, calls for very great vertical oscillations of land level or sea level. Evidence corroborative of such great changes is lacking. Erosion by submarine currents is widely questioned on the ground that the potency of such currents seems small in comparison with the results achieved. Various other interpretations meet difficulties equally formidable. It is believed that the hypothesis of spring sapping under conditions similar to, but not identical with, those now existing on land has advantages which make it worthy of serious consideration.

Biographical memoir of Wallace Hume Carothers: ROGER ADAMS. (Read by title).

Biographical memoir of Edwin Herbert Hall: P. W. BRIDGMAN. (Read by title).

SPECIAL ARTICLES

AN INTERMEDIATE HOST FOR THE SWINE INFLUENZA VIRUS

SWINE influenza is a disease in which two infectious agents, one a virus and the other a bacterium, are etiologically essential. The disease, either as it occurs naturally in the field or as it is transmitted experimentally in the laboratory, is highly contagious, and no intermediate host is required to explain its epidemiology, once an epizootic has started. However, no satisfactory explanation of how or where the disease persists during the 8 or 9 months elapsing between the yearly epizootics has yet been advanced. During such interepizootic periods the swine population in the middle western hog-raising states is, so far as can be told, free of swine influenza. The bacterial component of the etiological complex, *H. influenzae suis*, can persist apparently indefinitely in the upper respiratory tracts of some recovered swine, but similar persistence of the virus can not be demonstrated. The origin or source of swine influenza virus responsible for the fresh epizootics each autumn thus has remained obscure. It is with the epidemiology of these "first cases" of swine influenza that the experiments to be briefly outlined in the present paper are concerned.

Because the swine lungworm, a nematode parasitic in the bronchioles of the bases of the lungs of swine, enters prominently into the experiments to be described, a short account of its life cycle, as determined by the Hobmaiers[1] and by Schwartz and Alicata,[2] will be given. The cycle in brief is as follows. The embryonated lungworm ovum passed in the swine feces is swallowed by an earthworm, in which it hatches as a first-stage larva. After undergoing development within the earthworm the larva eventually reaches its third stage in which it is capable of infesting swine. It remains in this stage until its earthworm intermediate host is ingested by a swine, when it is liberated, penetrates the swine intestinal mucosa and migrates to the respiratory tract by way of the lymphatics and blood stream. The whole of this cycle can occupy a span of several years for its completion or, under the most favorable conditions, can be completed in slightly less than one month. Lungworms constitute a very common parasite in swine reared under the usual farm conditions.

In the present experiments feces and bronchial exudate, containing embryonated lungworm ova, and adult lungworms were obtained from swine that had been ill of swine influenza for from three to five days. This material, after mincing the adult lungworms with scissors to free their ova, was mixed with loamy topsoil and fed to earthworms. Beginning one month later, earthworms were removed from time to time, from the barrels of earth in which they were kept, for use in experiments. They were fed to swine intact but usually mixed with a small amount of dry grain feed. Two swine fed in this way in the first experiment remained apparently normal, and it seemed that the experiment must be interpreted as negative. These two particular swine had, prior to their earthworm feeding, been used in another experiment during the course of which they had received three intramuscular injections of a suspension of live *H. influenzae suis* at eight-day intervals. They had developed no illness. After the apparently negative result of the earthworm feeding there was occasion to inject them again intramuscularly with a suspension of live *H. influenzae suis*. On the third day following this injection they developed clinically typical swine influenza. With this fortuitous suggestion that a provocative stimulus was required to elicit infection, other similar experiments were conducted. Swine were fed the lungworm-infested earthworms and developed neither illness nor virus-neutralizing antibodies. After a period of observation of from 11 to 30 days they were injected intramuscularly with a suspension of living *H. influenzae suis*. No illness resulted from the first injection. However, when the injection was repeated eight days later, characteristic swine influenza resulted after three days.

In other experiments the procedure was varied to coincide with that of the initial experiment, and in these the swine received two preliminary intramuscular injections of suspensions of live *H. influenzae suis* at eight-day intervals before being fed lungworm-infested earthworms. After the earthworm feeding, sufficient time for the lungworms to complete their migration to the swine respiratory tract was allowed to elapse. Then the swine were again injected intramuscularly with a suspension of live *H. influenzae suis*. Swine influenza usually resulted on the third day after this injection, although in two instances its appearance was delayed until the fourth and fifth days.

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[1] A. Hobmaier and M. Hobmaier, *Münch. Tier. Woch.*, 80: 365 and 433, 1929.

[2] B. Schwartz and J. E. Alicata, *Jour. Parasit.*, 16: 105, 1929–30; 18: 21, 1931; and *U. S. Dept. Agric. Tech. Bull.* No. 456, 1934.

In all experiments the clinical diagnosis of swine influenza was confirmed either by the direct demonstration of swine influenza virus by mouse inoculation or by the development of specific swine influenza virus-neutralizing antibodies in the sera of swine that were allowed to recover. Numerous control swine have been given series of from three to twelve intramuscular injections of suspensions of living *H. influenzae suis* at eight-day intervals with entirely negative results. In like manner no swine fed the lungworm-infested earthworms has developed swine influenza without a provocative stimulus having been first applied. Earthworms that had been fed lungworm ova as long as three months earlier have been used successfully. The results of experiments over longer periods of time are not yet complete.

Swine influenza virus has not yet been demonstrated directly by mouse inoculation, either in earthworms known to be carrying infective third-stage lungworm larvae or in lungworms obtained from swine thought to be ready for provocation. If this finding is duplicated in a larger series of tests it would appear that the virus in the intermediate host is present either in very minute quantities or in a masked form. However, in a single experiment containing two swine, the animals were given the provoking stimulus and one was killed the day before the expected onset of illness. Swine influenza virus was demonstrated in or about the lungworms obtained from the bronchi at the bases of the lung of this animal but not in the anterior lobes usually involved in swine influenza. The following day the second swine in the experiment came down with typical swine influenza. It was autopsied, showed pulmonary alterations characteristic of early swine influenza, and swine influenza virus was abundantly present not only about the lungworms at the bases but in the pneumonic anterior lobes as well.

The present experiments have been conducted with known species mixtures of both lungworms and earthworms. Dr. Norman R. Stoll has kindly identified the lungworms employed as *Metastrongylus elongatus* and *Choerostrongylus pudendotectus*, while Dr. Libbie Hyman has tentatively identified the earthworms being used as *Helodrilus foetidus, Helodrilus caliginosus* var. *trapezoides, Octolasium lacteum* and *Lumbricus terrestris*. Furthermore, all experimental swine thus far employed have been carrying lungworm infestations of various degrees prior to their use. Experiments with single pure species of either lungworms or earthworms or with lungworm-free swine have not yet been completed.

The findings described are tentatively interpreted in the following way. Lungworm larvae from pigs with swine influenza harbor swine influenza virus throughout their development both in their intermediate host, the earthworm, and in their definitive host, the swine. The virus apparently lies latent within the lungworm after the parasite has finally migrated to the swine respiratory tract and is only liberated or activated to cause infection when a provocative stimulus is applied. In the experiments just outlined multiple intramuscular injections of *H. influenzae suis* are believed to have supplied the provocative stimulus. *H. influenzae suis* does not, however, appear to be specific or requisite as the provocative agent because, in a preliminary experiment, a single intrapleural injection of calcium chloride solution has served equally well in provoking the swine influenza virus infection.

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A CUTANEOUS TEST FOR TUBERCULOSIS IN PRIMATES

THE use of monkeys for experimental purposes has become so common during the past few years that many institutions now maintain permanent primate colonies. The chief single menace to the health of such colonies is tuberculosis.[1] Its incidence for 1936–1938 in the laboratories of the Yale University School of Medicine has been about 30 per cent., as determined by gross post-mortem examination. The desirability of reducing the spread of this disease by isolation of infected animals is obvious. The present report describes the results obtained by a simple diagnostic cutaneous test for tuberculosis.

MATERIAL AND METHODS

All departments in the Yale School of Medicine which maintain primate colonies cooperated in the study. Tests were made on 382 monkeys (353 *Macaca mulatta* [rhesus]; 17 mangabeys; 8 baboons; 4 Java monkeys); from the Departments of Anatomy, Obstetrics and Gynecology, Medicine, Pediatrics, Physiology and Primate Biology. Autopsies were done on 132 animals and the remainder were living (October 27, 1938) when this material was compiled.

The test[2] consists in the subcutaneous injection of

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[1] C. R. Schroeder, *Am. Jour. Pub. Health*, 28: 469–475, 1938.

[2] C. R. Schroeder, *Zoologica*, 21: 397–400, 1936.

old tuberculin (Schroeder uses P.P.D.) into the loose tissue about the eye where the erythema and edema of a positive reaction may readily be seen. At first, inoculations were made below the eye; later in the upper lid, since it was found that positive reactions were more conspicuous in the latter region, especially in the sooty mangabeys and Java monkeys in which the upper lids alone are unpigmented. The old tuberculin was diluted 100-fold in sterile physiological saline and 0.1 cc was used as the inoculum, which thus contained 1.0 mgm of old tuberculin. Positive reactions consisted in local redness and swelling. These varied in degree: in severe reaction the eyelids might become closed and necrosis and ulceration of skin might appear, as the reaction subsided. Usually the reaction was visible in 24 hours, increased for two or three days and then subsided gradually. Occasionally positive reactions were not apparent until the third or fourth day. If no reaction was seen by the fourth day the test was considered negative. In the colony of the Department of Pediatrics direct smear examination of suspected material for tubercle bacilli was also made at autopsy.

In reading the tables (I, II and III) attention should be directed to the fact that statistics from the various colonies differ because of the rate of turnover. Thus, the colonies of the Departments of Anatomy, Obstetrics and Gynecology and the Laboratory of Primate Biology are kept for long-term experiments, and new (potentially infectious) animals are rarely introduced. The animals in the Departments of Medicine and Pediatrics are used rapidly in contrast and those of the Laboratory of Physiology somewhat less rapidly.

TABLE I

PRIMATE TUBERCULIN TESTS (APRIL–OCTOBER, 1938)

Department of	Tested	Positive	Negative	Equivocal
Medicine and Pediatrics	136	44	90	2
Physiology	99	8	91	
Gynecology and Obstetrics	64	3	57	4*
Anatomy	59	15	44	
Primate Biology	24	0	24	
Total	382	70	306	6

* Previous immunization with B. C. G.

TABLE II

PRIMATE AUTOPSIES (APRIL–OCTOBER, 1938)

Department of	Total	Positive	Negative	Equivocal	Insufficient data
Medicine and Pediatrics	86	33	51	2	
Physiology	23	8	12	2	1
Gynecology and Obstetrics ...	3	3			
Anatomy	20	15	2		
Primate Biology .	0				
Total	132	59	65	4	4

TABLE III

CORRELATION OF TUBERCULIN TESTS AND AUTOPSIES

Department of	Test and autopsy positive	Test and autopsy negative	Test negative, autopsy positive	Test positive, autopsy negative
Medicine and Pediatrics ...	23	48	5	3
Physiology	7	12	1	1
Gynecology and Obstetrics.	3	0	0	0
Anatomy	12	2	3	0
Total	45	62	9	4

RESULTS

The results are presented below: Table I shows that 70 monkeys, roughly 20 per cent. of the total, furnished positive tests. Table II shows that among 132 autopsies 59, or 45 per cent., revealed the presence of tuberculosis. Not shown in the table is the fact that this was confirmed by finding acid-fast bacteria on direct smear in 31 of 33 trials. The correlation between tests and autopsies is presented in Table III, which shows that 49 positive tests were confirmed by autopsies 45 times, and 71 negative tests were contradicted at autopsy 9 times. In other words, a positive test correctly indicated gross tuberculosis in 92 per cent. of 49 trials, and a negative test incorrectly indicated the absence of tuberculosis in 13 per cent. of 71 trials.

DISCUSSION

Some of the failures in correlation might have been avoided by repetition of the test or by using larger doses. However, even in man the test fails at times, and this test, which is approximately 90 per cent. accurate, is of great service in detecting tuberculous monkeys.

CONCLUSION

The periorbital subcutaneous inoculation of 1.0 mgm of old tuberculin is of practical value as a test for the presence or absence of tuberculosis in several varieties of monkeys.

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THE QUANTITATIVE DETERMINATION OF SOY-BEAN PROTEIN IN SAUSAGE OR OTHER PROTEIN MIXTURES

GOVERNMENT restrictions forbidding the use of soy-bean flour in sausage or other meat used in interstate commerce is based on the lack of a reliable test for the quantitative determination of soy-bean protein in such meat. The nutritional value of soy-bean is not questioned. At the present time no strictly chemical method of assay has proven reliable.

We have recently obtained accurate quantitative results by the use of an immunological method which is both simple and rapid. The method is based on a quantitative precipitin test, the "optimal proportions" reaction, first described by Dean and Webb[1] and subsequently proven by Taylor, Adair and Adair[2] to be well within the limits of accuracy of the best-known chemical methods.

The test depends on the fact that in any antigen-antibody titration system the velocity of the reaction is related to the proportion of antigen to antibody. Thus, for a given antibody, precipitation is most rapid when the ratio of antigen to antibody is at an optimum which can be readily determined. This optimum ratio is a constant for each antibody solution and is independent of the concentrations of either antigen or antibody in any specific test.

For example, suppose a given antigen reacts most rapidly with a given antibody at a ratio of 1 to 50; that is, one part of antigen forms a precipitate with 50 parts of antibody at a faster rate than with 45 or 55 parts of antibody. In fact, any ratio other than 1 to 50 will be slower than this optimum. Then, since this optimum ratio is a constant, the actual concentration of reagents may vary within fairly wide limits. It may be 3 to 150 or 10 to 500 or 25 to 1,250.

It is a simple matter to standardize any particular antibody against a known antigen in terms of optimal ratio. Using this ratio the concentration of antigen in any unknown mixture can be determined.

In the specific instance of quantitative assay of soy-bean protein in sausage, the test is performed as follows:

Rabbits are immunized against a 5 per cent. NaCl extract of soy-bean flour. For practical purposes, it is unnecessary to use purified glycinin. Several courses of injections over three or four months are usually necessary to produce a serum of satisfactory potency. The serum is collected and standardized against known soy-bean flour extract. Its optimal ratio is determined as accurately as possible. This ratio is then a constant for that particular serum.

Sausage containing soy-bean flour is extracted with 5 per cent. NaCl. This unknown extract is then titrated against the standard serum and its ratio determined. By dividing the test ratio by the standard ratio the percentage of soy-bean protein in sausage is given.

For example, a standardized serum had a ratio of 1 to 30 against pure soy-bean flour extract. An extract of sausage gave a ratio of 1 to 3 with this serum. Therefore the sausage contained 10 per cent. of soy-bean flour. The accuracy of the method is limited only by the care with which the test is performed; that is, the ability of the operator to distinguish the most rapidly precipitating tube in a rack of ten or twelve tubes. The specificity of the method is limited only by the phylogenetic relationship of the protein mixture under test, a well-established immunological fact.

Details of the test will appear in a subsequent publication.

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[1] H. R. Dean and R. A. Webb, *Jour. Path. and Bact.*, 29: 473, 1926.

[2] G. L. Taylor G. S. Adair and M. E. Adair, *Jour. Hyg. Camb.*, 32: 340, 1932.

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HISTORY IN THE ARCHIVES OF THE ROYAL SOCIETY[1]

By Sir WILLIAM BRAGG

DIRECTOR OF THE ROYAL INSTITUTION OF GREAT BRITAIN; PRESIDENT OF THE ROYAL SOCIETY, LONDON

THE archives of the Royal Society are rich in materials that illustrate various aspects of the history of the last three centuries. They have, of course, a special character, since they refer almost entirely to the matters in which the society has concerned itself, grouped under the general title of "The Improvement of Natural Knowledge." But these matters have increased in importance with the passing years and are now a subject of the first concern of the whole world. The effect of science upon social relations and social conditions has become very great, and the gains are obvious. Yet science does not appear to be in all cases beneficent. It has become a matter of anxious consideration whether or no the increase in the knowledge of nature must necessarily bring evil as well as good. Is there a fault to be remedied, and if so where does the fault lie? These questions have roused a debate which is even now in progress, and some hard thinking is being given to them.

It is of some help, I think, to consider the steps by which the present position has been reached, and the Royal Society archives may be used to provide the necessary illustrations. For that reason I hope that you will find it of some interest if, with that object in view, I refer to some of the papers and letters which they contain.

A few "virtuosi," to use the contemporary phrase, who met for discussion and experiment in the middle years of the seventeenth century were weary of the miseries of the civil war, and were glad to turn their thoughts to the consideration of natural phenomena over which the passions of men had no influence. Experimental science had long tempted thoughtful minds, and now the first founders of the Royal Society threw themselves with thankful relief into a work which seemed to them to be both a pressing duty and an absorbing occupation. They were like boys let out of school rushing out into the surrounding world to explore brooks and hedges and anything that seemed interesting. When I take down the first volumes of the *Transactions* from their shelves or look through the early manuscripts at the Royal Society, I feel as if I was turning out schoolboys' pockets and finding the usual assortment of mixed oddities.

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[1] Pilgrim Trust Lecture, delivered before the National Academy of Sciences, April 24, 1939.

In its first efforts the society was mainly concerned with the collection of information. The leading fellows sent questionnaires to various parts of the world which in their demand for comprehensive detail would have done credit to any inquisitive department of a modern government. An admirable example is to be found in the series of questions drawn up by Lord Brouncker and Mr. Boyle and approved at one of the earliest meetings of the society; in which most appropriate suggestions were made as to what should be looked for on an ascent of Teneriffe. It shows no little knowledge and penetration to inquire whether a "filtre or siphon" would work as well at the top of the mountain as at sea level, whether a bell or watch or gun would give the same sound, a flame have the same appearance, whether a pendulum clock went at the same rate, whether birds of heavy flight would fly as well or better or worse, and so forth. It was quite apt to ask what alterations would be found in living creatures carried to the top, both before and after feeding, and "what the experimenters do find in themselves as to difficulty of breathing, faintness of spirits, inclination to vomit, giddiness, [illegible] On March 28, 1672, Lord Henry Howard presented the answers to a series of questions on Barbary, where a retainer of his had recently been traveling: a remarkably pictorial account of the country and its inhabitants. It was expected apparently that some trace of the arts and sciences were to be found there, no doubt because it was known that the Arabian races had handed on the knowledge of the old world to the new. But there was no learning at all. In particular "there were no chemists except Jews and Christian slaves that distilled brandy in jars." So too a good account is given of Hudson's Bay and its people by a Captain Guilliaume and a Mr. Bailes, who had recently voyaged there. Naturally most of the information related to navigation and trade, but it is interesting to find also an account of the Maneto or Supreme Power and of his priest the Pawaw. The early records contain many such questionnaires and replies thereto.

Robert Boyle was the center of a vast correspondence on scientific and other matters, and fortunately a large collection of his papers is possessed by the society. Many of these have been published in his well-known "Life and Works." Quite a number of them crossed the Atlantic, and you will not blame me if I choose some of them to illustrate what I have to say. They were in the main of the informative type on which such great value was set. Thus a certain P.S. writes from Virginia on August 29, 1688, describing humming birds, also wampum, roanoke and pook, which were forms of currency. The trade measurement of length was the primitive cubit. The climate of New England was a frequent topic; it was supposed to be changing for the better. Perhaps under improving conditions the settlers were less susceptible to its rigors.

The governor of Boston, Leverett, and the deputy governor, Symonds, with other of their fellow citizens write to Boyle in protest against charges of disloyalty to the King, anxiously rebutting accusations of neglecting the baptism of infants and so forth. In 1682, Hezekiah Usher begs the remittance for 21 years of the King's claim for one fifth of all minerals recovered, so that prospecting may be encouraged.

Boyle's correspondence was, as the last two extracts show, by no means confined to scientific matters. After all, the first founders of the society were either statesmen themselves or closely connected with statesmen and might well be supposed to be proper persons to be entrusted with important news. Thus Richard Wharton writes from Boston in 1676, warning Boyle that the French are working round the interior of the settlements towards Carolina and the South. In 1684 Randolph writes from New England of the possibility of drawing on the vast forests of Maine for supplies of masts and timbers for the Navy, and discusses methods of making pitch and resin which are a secret of the French. John Winthrop writes in the same strain, urging the Royal Society to approach the government on the matter: he explains that there are sawmills handy to rivers, houses and provisions for workmen who may be sent, that small ships up to 400 tons have already been built. The supply of timber for the Navy was one of the greatest anxieties of Great Britain, from the time of his correspondence until steel replaced wood. Dry rot was a terrible curse from which the navy suffered more than the merchantmen, because the latter were more often aired and open to inspection during the loading and unloading. A strange story of its ravages is told by Ramsbottom in the *Essex Naturalist*, Volume XXV. Among the incidents of that story is the probable failure of the *Speedwell* to accompany the *Mayflower* on acount of dry rot.

It is well known that Boyle was deeply interested in the conversion of the Indians and that the Society for the Propagation of the Gospel owes much to his initiative. In 1664 he receives a letter from John Endicott, of Boston, describing the progress of the mission. John Eliot, also of Boston, writes frequently, expressing deep gratitude, and hopes for further help.

His address to Boyle was always eloquent, as for example "To the Right Honorable Learned abundantly charitable and constantly noursing Father."

In modern times it is an honor and an honor only to be elected a correspondent of a learned society. But a correspondent of the Royal Society in its early days was expected to correspond. When Cotton Mather was advised that he had been elected a fellow he wrote in 1715 to his friend Richard Waller, the society's secretary—the letter is in the society's archives—saying that

> . . . the tendency [of the society] to Refine and Sweeten the minds of men, and reconcile them unto Just Regards for True Merits in one another, with an extirpation of that noxious clamour the party spirit, and finally how generously the more polite Literators of the world go on in it, with a decent contempt on the Banters of the Bruitish among the people, but the result of his consideration will be that it will be a greater honour to be taken into the list of your servants, than to be mixed with the great men of Achaia.
>
> One who is entirely of that opinion, having been so listed with you has been desirous to discharge his obligations by agreeable assiduities, and therefore besides what every year brings you from him as an addition of Curiosities to the rich and vast assessment you are preparing he has bestowed a few hours upon the Philosophical Religion which he now humbly tenders to your acceptance.

The "Curiosities" here referred to became a famous object of interest in London; the collection was known as the "Repository." It grew to so great a size that the society found it unmanageable, and handed it in 1782 to the British Museum, which had been founded a few years before in order, in the first place, to contain the collections bequeathed to the nation by Sir Hans Sloane. Sir Hans was president of the society from 1727 to 1741.

The "Banters of the Bruitish" must clearly refer to the scornful comments of many clever men who did not sympathize with the experimental study of the world, who resented the intrusion of the new knowledge and laughed at the apparent futility and irrelevance of its beginnings. If they did not foresee the magnitude of its consequences they were little more at fault than the experimenters themselves. How could intelligent men waste time on objects so small that they must be examined under the microscope? Or on the consideration of such intangible substances as the air? How could they give serious attention to the abnormalities and monstrosities that idle correspondents thrust upon them? And, of course, the society did at first give their time to many accounts that even then must have looked ridiculous to men of a serious and settled mind. There were, for example, reports of a calf that had its hair inside out, of a man who squinted only on alternate days, of another who could not see if his hair were suffered to grow more than an inch long. It must have been quaint hearing when Dr. Tyson, at a meeting of the society, declared that one of his teeth having been drawn at Oxford some years before had been replaced and had apparently taken root again, since it was still of use. In those early days of inquiry it was of course necessary to sift all information that came to hand, but it would certainly be difficult for the unscientific mind to see the point in all cases. Dean Swift was a violent critic of the society's doings. It will be remembered that in his stay in the island of Brobdingnag Gulliver had an encounter with two wasps nearly as big as himself. He slew them with his sword and cut out their stings, which he brought eventually to England and presented to the Royal Society for its "Repository." In the voyage to Laputa, Gulliver found men, corresponding obviously to the physiological members of the society, who did remarkable experiments on men and animals. It is curious that Swift's wild inventions, which were intended as caricatures, are not unlike some of the beneficent methods of modern healing. It would not be very difficult to carve out a claim for Swift to be in some respects a pioneer of medicine as it is practised to-day.

These oddities were, however, an insignificant part of the society's proceedings. Of far more importance among the society's early papers are such as deal with the pressing questions of the day. Navigation claimed much attention. I have already referred to the anxieties respecting a sufficient supply of masts for the Navy. Perhaps the Dutch and French were aware of those difficulties [illegible]n, as Ramsbottom remarks, they were accustomed to fire high in a sea fight.

At the end of the seventeenth century ships were growing considerably in size, since now they must become accustomed to the crossing of the Atlantic. Many English ports were unable to provide water of sufficient depth at all states of the tide, and tide tables were urgently required. Their calculation required the cooperation of mathematicians and astronomers. The archives contain of course many communications relating to the foundation of the Royal Observatory at Greenwich.

Pepys, when he was president of the society, begged continually for information on any matter whatever that might assist him in his care for the Navy. Probably he was really disappointed when Sir William Petty's double-bottomed ship turned out so badly, though he had made his bet that it would. Petty, a very able man, had supposed that a ship resembling in form two ships lashed side by side would stand up to a cross wind better than a ship of ordinary design. The idea was that, of course, which is embodied in the outrigger of some Polynesian races. Again, there is an interesting note in the account of the *Proceedings* of July 28, 1686.

> . . . it was remarked that sheathing with lead was the best expedient (for preserving ships from the worms) and found to be so by the experience of Sir Anthony Deane; but that the carpenters finding it against their profit opposed it by affirming that the iron of the pintles of the rudders of ships so sheathed were much more apt to be corroded by the sea water than those sheathed with wood which yet was a groundless supposition.

The carpenters had more reason than was supposed: we know now that electrolysis can be exceedingly troublesome.

So also the ventilation of coal mines was an urgent question, and is frequently referred to in the archives. It had become necessary to dig deeper than before. The accumulation of water became a serious hindrance and the many noxious damps were often fatal. Air pumps and water pumps are dealt with in numerous well-known papers by Boyle, Hooke, Papin and others. Sir Robert Moray wrote on the ventilation of mines in Belgium. There was much correspondence on the subject. Its general character may be illustrated by an extract from a letter which a certain Dr. Jessop of Yorkshire wrote to the society in 1675. Let me give it in its original form, which now sounds so quaint.

> There are four sorts (of damp) common in these parts. The first is *Ordinary Sort* of which I need not say much being known everywhere: the external signs of its approach are the candles burning orbicular and the flames lessening by degrees until it quite extinguish; the internal, shortness of breath. I never heard of any great inconvenience which anyone suffered by it, who escaped swooning. Those that swoon away and escape an absolute suffocation are at their first recovery tormented with violent Convulsions, the pain whereof when they begin to recover their senses, causeth them to roar exceedingly. The ordinary remedy is to dig a hole in the earth and lay them on their bellies with their mouths in it: if that fail they tun[2] them full of good Ale: but if that fail they conclude them desperate.

These few extracts from the records of the society will serve, I hope, to convey an impression of the character of the society's activity in its early days, when first an organized attempt to collect knowledge by experiment and observation began to exercise its influence. At whatever point one picks up the story as it is told in these old records, one finds it full of interest, which lies not only in the subjects that are dealt with, but also in their relation to the activities of the time, and to the men themselves whose handwriting lies before one.

It is to be observed that these records are easily read by an educated man. Those who wrote them had in general no thoughts which the educated man could not follow, nor was it necessary to use terms which were not in ordinary use. Newton's "Principia" would, of course, be intelligible to a small number only, but in general the "virtuosi" spoke a common language. The days of specialization and division into separate societies had not begun. How great is the contrast with the publications of a modern learned society!

It is also to be observed that there is no strict reckoning of services rendered, and no calculated recompense. Men like Hooke and other immediate servants of the society were paid for their work as was necessary and right, though the amount was incommensurate with their deserts. But the labors of the enthusiastic fellows and of their correspondents in all parts of the world were given freely. Indeed the society had no money to pay with. It received no financial assistance from the government, and the fellows' subscriptions (which, by the way, the treasurer found it remarkably difficult to collect) covered only the necessary expenses of the meetings. When the society decided to print the "Principia" Dr. Halley himself provided the necessary funds. To this day, the fellows give without reward the services which their connection with the society entails. But I do not ask for any special commendation; the point is that such free service is common among learned societies, and is certainly a chief reason why they are held in respect.

The general intelligibility of the communications to the Royal Society persists for a long time. The calculations of the astronomers, the mathematicians, opticians and so forth appealed naturally to a limited number, but still we may suppose that fellows were able to understand the most part of that to which they listened. Perhaps it may be said, broadly, that the change begins when new terms must be invented to describe the increasing complexity of observations, and new units for quantitative description. Electricity and magnetism have been chiefly responsible; so that the experiments on frictional electricity which were so popular in the middle of the eighteenth century are especial objects of interest. The progress of the subject is illustrated in the society's archives by the many papers and letters of Watson, Franklin and others. Franklin's communications came by way of his friend Collinson, who gave them to Watson for presentation to the society. Watson was himself a keen student of frictional electricity; and it would seem that some of the important experiments were made by Franklin and himself independently. But Franklin was of course the greater man, and Watson gave him full praise: "Although there are in the work some few opinions in which I can not perfectly agree with him I think scarce anybody is better acquainted with the subject of electricity than himself." Franklin was advised by his friend Mitchell that the paper on the subject of the identity of the lightning flash with the sparks of the electrical machine were received with laughter by the Royal Society. But the records in the *Journal Book* and elsewhere seem incongruous with such an occurrence. The warmth of Watson's praise, though he was an independent worker, his recommendation that Franklin's papers should be accepted, the repetition of Watson's commendation by the president when awarding Franklin the Copley medal all go to show that there was probably no more than a hesitation to accept Franklin's view of the particular paper to which Mitchell referred; and the absence of some papers from the *Transactions* may well have been due to an arrangement with Collinson, who regarded the communications which he had received as private letters. At that time the *Transactions* of the Royal Society were not printed by the society itself but privately and independently.

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[2] A tun is a cask that bulges in the middle and the meaning of the verb is associated with that of the noun.

The many papers in the archives that refer to frictional electricity form in themselves an interesting collection, showing the keen interest felt in the phenomena by experimenters in Europe and America; and they give additional strength, if it were needed, to Franklin's great reputation.

There is an interesting letter of Franklin's which describes an experiment of his friend Kinnersley's, who was unable to give a satisfactory explanation of it. Franklin was himself perplexed at first. The experiment consisted in the "electrification of the air in a room" or even the air outside; when the air was changed the electrification did not disappear. At first Franklin thought that there might be some stationary medium which held the electrification, and allowed the air to percolate through it: but he observed that Kinnersley had put his two light bodies, by the repulsion of which the charge was observed, in a glass phial, and he came to the conclusion that the air gave some of its electrification to the glass.

Thus electricity was already, in the middle of the eighteenth century, offering a new field of experimental inquiry, and the importance of it was becoming realized. In the words of Martin Folkes, president from 1741 to 1752:

> Electricity seems to promise an inexhaustible Fund for Inquiry: and sure *Phenomena* so various and so wonderful can arise only from Causes very general and extensive, and such as must have been designed by the Almighty AUTHOR OF NATURE for the Production of very great Effects, and such as are of great Moment to the System of the Universe.

The numerous papers on frictional electricity form one of the most interesting sections of the archives during the eighteenth century. The society's membership did not equal in brilliance that of the centuries that preceded or followed. But there were several great subjects of consideration besides that in which Franklin made so prominent a figure. A large collection of Fahrenheit papers shows the interest taken in thermometers in the earlier part of the century. Another large collection deals with inoculation against smallpox. At the end of the century Rumford describes his beautiful and valuable experiments on heat: he is prolix of words, but he makes excellent reading. He was, of course, a pioneer in the experimental study of the nature of heat. His work is well illustrated in the society records. At the turn of the century, 18th to 19th, the chemical investigations of Humphry Davy introduced a brilliant period in British science, and these also are well recorded. The first quarter of the nineteenth century was not, however, a happy time for the society. Internal dissensions and unchecked growth of membership and the formation of societies which were formed to take over special sections of the society's work till then unrestricted, all tended to reduce the value of the records and their interest. There were denunciations of the management and laments over the decline of science. Yet one of the greatest periods of scientific discovery had already begun, with Young, Fresnel, Davy and Faraday. But now the language began to be more difficult to the uninitiated. When the phenomena of electricity, magnetism, chemistry, light came to be studied in their mutual relations, the new world in which they figured was difficult of entry. This was not only because ideas were new and could only be represented with the aid of analogues, such as current, pole, capacity and the like, but also because new terms had to be invented to provide labels for conceptions which had never entered men's minds before. What, for example, could such words as anode and cathode mean to the non-electrician? So the ordinary reader is left behind, and the language of science becomes rapidly specialized.

It is interesting to observe the care with which Faraday chose his terms. He was in the habit of consulting Whewell, the master of Trinity College, Cambridge; the correspondence is preserved in Trinity College Library and in the Royal Institution. A letter in the possession of the Royal Institution reads as follows (Whewell is replying to Faraday):

> . . . I still think *anode* and *cathode* the best terms beyond comparison for the two electrodes. The terms which you mention in your last show that you are come to the conviction that the essential thing is to express a *difference* and nothing more. This conviction is nearly correct, but I think one may say that it is very desirable in this case to express an *opposition* a contrariety, as well as a difference. The terms you suggest are objectionable in not doing this. They are also objectionable it appears to me in putting forward too ostentatiously the arbitrary nature of the difference. To talk of Alphode and Betode would give some persons the idea that you thought it absurd to pursue the philosophy of the difference of the two results, and at any rate would be thought affected

> by some. Voltode and Galvanode labour no less under the disadvantage of being not only entirely, but ostentatiously arbitrary, with two additional disadvantages; first that it will be very difficult for anybody to recollect which is which; and next that I think you are not quite secure that further investigations may not point out some historical incongruity in this reference to Volta and Galvani''
>
> . . . I am afraid of urging the claims of *anion* and *cation* though I should certainly take them if it were my business—that which goes to the *anode* and that which goes to the cathode appearing to me to be exactly what you want to say. To talk of the two as *ions* would sound a little harsh at first: it would soon be got over.

The selection of the terms anode and cathode were based on a suggestion made by Faraday. In order to obtain a description which he could remember he supposed his electrolytic trough to be placed parallel to the equator, and the current in the trough to run in the direction in which a current would have to run round the earth in order to give to the earth its observed magnetism. This implied that the current ran from east to west. It came, therefore, from the sunrise and went to the sunset, and the terms anode and cathode were taken as describing the way of the sun in the morning and in the evening.

You may be interested if I recall to you an item of history. Not long ago the council of the Royal Society decided to open some sealed letters which had been deposited with the secretaries a century ago and more. There was no apparent reason why their contents should still be kept secret. One of them was written by Faraday in 1832. It read as follows:

> Certain of the results of the investigations which are embodied in the two papers entitled Experimental researches in Electricity, lately read to the Royal Society, and the views arising therefrom, in connexion with other views and experiments, lead me to believe that magnetic action is progressive and requires time; *i.e.*, that when a magnet acts upon a distant magnet or piece of iron, the influencing cause (which I may for the moment call magnetism) proceeds gradually from the magnetic bodies, and requires time for its transmission, which will probably be found to be very sensible.
>
> I think also, that I see reason for supposing that electric induction (of tension) is also performed in a similar progressive way.
>
> I am inclined to compare the diffusion of magnetic forces from a magnetic pole, to the vibrations upon the surface of disturbed water, or those of air in the phenomena of sound, *i.e.*, I am inclined to think the vibratory theory will apply to these phenomena, as it does to sound, and most probably to light.
>
> By analogy I think it may possibly apply to the phenomena of induction of electricity of tension also.

Faraday had learnt the advisability of preserving evidence such as this in case he might seem to have adopted the ideas of others. It shows that Faraday's conception of electromagnetic pulses or waves occurred to him long before he published his paper on "Thoughts on Ray Vibrations" in 1846. Curiously enough, when the society's librarian was helping me to gather these few notes, a slip of paper fell out of one of the books consulted. It is in Maxwell's handwriting:

> The electromagnetic Theory of L^{t} as prop^{d} by him (Faraday) in Thoughts on Ray Vibrations (Phil. Mag. 1846, May or Ex.Res.III.p.447) is the same in substance as that wh. I have begun to develope in this paper (A Dyn^{l} Th^{y} of the E^{c} Field. Part VI pp497–5 Ph Tr 1865) except that in 1846 there were no data to calculate the vel of propagation. J.C.M.

The passage was subsequently incorporated in Maxwell's papers.

Many groups of papers in the archives relate to work done for the government, or for national enterprise, eclipse expeditions, biological and geodetic expeditions and so on. There is an interesting bundle of Sabine papers which have not yet been published. Sabine (1788–1883) was largely responsible for magnetic surveys in various parts of the world. Not a little of it is concerned with New England. There are letters from G. P. Bond, of Cambridge, the astronomical observer of the American Academy of Arts and Sciences, discussing the magnetization of the earth; from I. M. Gillin, of the Observatory at Washington; T. D. Graham, of Baltimore; A. D. Bache, belonging to the Coast Survey, and so on. A letter from the secretary of the American Academy announces the appropriation (22 April, 1840) of $1,000 for the purchase of instruments recommended by the Royal Society.

I shall say nothing of records more recent. We are all familiar with the bold advance of modern science, and extracts from the archives relating thereto would be superfluous. Specialization continuously increases. Papers become ever more complicated, each appealing only to a fraction of the scientific world and not at all to the general reader. The change from early times is very great indeed. It is inevitable and it implies success in experiment and deduction. But its effects are serious and must be examined carefully.

These extracts show, I think, that the archives furnish a rich commentary on the history of the period during which the Royal Society has been in existence. They show too that the society has played no small part in the doings which that history records. The new spirit which gave rise to the society demanded that action should be based upon experimental research and however spasmodically the world as a whole has obeyed this new principle, however ignorant men of all kinds, rulers and ruled, have been of the working of the leaven, the change in the ordering of men's activities has proceeded steadily and strongly. It has grown as the roots grow underground, preparing the life of the plant when the time comes for it to flourish. That time is already here, if we may judge by the extent to which natural knowledge is now used in all that men do.

We now observe the flower and the fruit that it bears. As we all know, we have reason both for satisfaction and for anxiety. We do see the happy results of a better acquaintance with nature in a greater freedom from disease, in a richer life, in new opportunities for the exercise of talent, in a wider outlook. On the other hand, the problem of the well-being of the community is still far from complete. Not long ago your American Association for the Advancement of Science met in Richmond to hear a noble address from its president. The very title of his address, "Intuition, Reason and Faith in Science," was an indication of the position from which many of our most thoughtful scientists regard the problem as it stands to-day. From our side of the water we were glad to send Sir Richard Gregory to show that we also are trying to take our bearings for a new advance. We can not stand still, of course; we must go forward, even though the way is not clear. We know the strength of science, we see that it has done great things, and are confident that its powers can be employed with greater and greater success as we give our whole minds to the problem that we have to solve. How shall we ensure the right use of natural knowledge, give full play to its beneficence and prevent its abuse? You and we and, let us hope, all associations of scientific men the world over are of one mind in this matter, and are glad of the strength that unity brings.

The very fact that we share this good-will points to the road that we must take. The good-will that is based on our mutual understanding of what we are striving for is somehow to cover the world. I have not of course the presumption to say that science is by itself to leaven the whole. There are other incentives to cooperation; first and foremost stand the binding forces of pure religion. But the cooperation of the scientists is a new leaven, though it is not the first in the field. It is our own contribution which, if we can make, we must make or we fail in our duty to the world. I assume that we accept the duty.

We can surely conclude, from what we learn in the accumulated accounts of their doings, that the learned societies have not been unmindful of this primary purpose. No doubt in the early days when men collected facts as matters of interest, the recitals to which they listened were to many of them a private benefit only. Yet there were always men of wider vision who saw also the future benefit to their country or the world in the ordering of natural knowledge. The archives of the Royal Society into which I have dipped here and there in order to provide illustrations of my argument show the continuous endeavor of a body of scientists to be of help to their fellowmen. They may not have been always conscious of such an effort; in any community you may find some who are purely selfish. But as a body of men, vivified by those who had in them most of the right spirit, they have played a great part and I believe firmly a beneficent one.

We can not but ask ourselves whether it is possible to say that such and such actions and dispositions of societies like yours and ours have been the dispensers of good, while others are to be set on the opposite side. Some results derived from science are good: some already are bad. Are these antitheses related to similar opposites in our work as scientists?

Most thinkers now agree that we are not responsible for the uses that are made of the knowledge we find. We can not control the strong passions that seize upon discoveries for selfish purposes. The work of discovery goes on and no one can stop it, not even ourselves. The constant demand for knowledge that is required for the solution of problems in health, in industry, in every human activity is so insistent that knowledge increases continuously and rapidly. And even if there were not this practical urge there would be the never-failing curiosity to know more. We must therefore accept the position; we all seek for an understanding of how to make the best of it.

I have referred already to the addresses given recently by Dr. Birkhoff and Sir Richard Gregory. They illustrate a movement which gathers strength. It is based on an anxious determination to find out how the new situation is to be gauged and treated, and in particular, what the scientist may do. There is so much inquiry to be made before an answer can be given to this general question that it would be wrong to anticipate a conclusion. We can only remind ourselves of a few obvious lines of action, which we take in the expectation that the less obvious will become clear.

There is the great question of right exposition. It may be that there are some who would even now disclaim any duty of scientific men in this respect; and certainly there were many who would have done so in the past. If, however, we suppose that natural knowledge and the power which it gives are a common possession of mankind, we ought to make sure that what is found is understood. We can not compel men to make use of science in the right way, but the chance that good use will be made is in a curious way dependent on the ease with which it is stated. If its expression is in forbidding terms, the man who sees no direct benefit from the effort of facing a difficult understanding leaves it alone. On the other hand, the man who is engaged in a fight against his fellows, whether in business or in war, grasps at any advantage that knowledge gives him, if he becomes aware of it. And of late years such men have seen the advantage, whence comes much of our present perplexity. The world is horrified by the development of frightful engines of war. It observes too that a technical invention, based it may be on some new scientific discovery, may throw great industries out of gear and bring misery upon employers and employed. These are obvious evils, and it is not surprising that the proper desire to increase knowledge is supposed to be associated with a tendency, even a desire to make ill use of that knowledge. Also those men of good will who are acquainted with scientific aims and achievements have their own peculiar distress because they know how little is done for the general good, compared to what could be done.

Exposition, therefore, becomes one of our chief concerns. It must be mated necessarily with the understanding that appropriate education can provide. We desire that all men and especially men of good will, and especially also men of good education who are the natural leaders should be aware of what science is doing and can do. A certain surviving distrust based on past misapprehensions has to be cleared away and replaced by cooperation.

I was standing once on the platform of a little up-country railway station in Australia, with others who had come to share the mild excitement of the arrival of the infrequent train. There was bustle when the train was ready to start, flag waving, bell ringing and cries to stand back. The engine whistled loudly, and went off by itself: the coupling with the train had been forgotten. There was a moment's pause, and then a shout of laughter while the shamefaced officials set out to repair their mistake.

There is something like that in what is taking place to-day. Scientists are so preoccupied with their business of research, naturally so, and in their researches have gone so far that the world has no clear knowledge of the positions that have been reached. We have to see to the coupling and take the world with us. It may seem ungracious to make a statement of this kind when so much is already being done to popularize scientific knowledge. Yet it is to be observed that much of the science which is absorbed by the people lies on planes of lower value. Some that is intended for popular enlightenment is of that kind which seeks to dazzle by the recital of huge numbers. We must, of course, learn how narrow is our knowledge if we limit it to the consideration of spaces of about the same magnitude as our own bodies, or of times comparable with our own length of days. But that is a lesson in humility; the mere staring at big figures is childish if there is nothing more.

There are scientific writings which tend to be mystical and need very careful reading, lest they seem to contain a meaning when in fact they do not. Some of the terms used to describe scientific observations are drawn from the general vocabulary, such as wave, vibration, ray, ether and so forth, and are defined or redefined for the specific purpose. If they are allowed to carry at the same time any unrestricted meaning that can be given to them in ordinary usage an argument which includes them gets out of control and leads to danger.

The observations of natural science, though they have now passed far beyond the range of the unaided senses, have not left the plane in which eyes and ears are accustomed guides. Neither they themselves nor any combination of them rise to a higher plane: that is reserved for conduct, which, however, must take account of them.

The understanding of science that should be general to all men is of a simpler kind. It rests on a knowledge of the elementary laws of nature, so far as we can ascertain them, and an appreciation of their continuous influence upon our lives. It leads to an awareness of the general position, though not necessarily a detailed acquaintance with it. It couples us all together in the desire to learn from nature. We enrich our own lives, and we learn how to enrich the lives of our neighbors; but the great happiness lies in the discovery that there is a world in which we can all work together for the common good, in which there is endless work to be done, and an unselfish purpose can lead us from strength to strength.

Herein lies the finest work of science. Even the relief from pain and disability, the increase both in quality and in quantity of the fruits of the earth, the betterment of all the conditions of life are not the end; there is something higher. It is the mutual service that is rendered when these things are fought for, and the happiness of mutual trust and reliance, and the last great act of virtue, that is to say the sacrifice of self. To quote from Dr. Birkhoff's address: "I would state a fundamental truth about the social level which in some sense is the highest level of all [ranking, that is to say, above four other levels which he described, mathematical, physical, biological, psychological]: the transcendent importance of love and good-will in all human relationships is shown by their mighty beneficent effect upon the individual and upon society."

Collectively and individually scientists have done great things. Yet their achievements have value of one kind, and the spirit in which they worked has value of another kind; and the latter value is far more to be desired than the former. We may truly say of some of our greatest men of science that the world has gained more from their lives than from their discoveries, and this is so even if their influence on the world is limited to that which the world has been able to perceive. Their discoveries made them famous, but they themselves are better known than their discoveries. Faraday's reverence for truth and unselfish devotion to its acquisition have a higher value than the laws which he established. We gladly admit our debt to Pasteur and to the Curies, and yet the inspiration which we draw from their lives is even better than the results of their work. The world admires Franklin for his discoveries in electricity, yet it respects him more for his wisdom. I might prolong the list, but every one here can do that for himself. In brief the spirit in which knowledge is sought and the manner in which it is used are more important, more real than knowledge itself.

The records of scientific discovery, of the development of the fields of experiment which began three hundred years ago, have shown the growing power of science. The extent of their power is to-day a chief concern; we must, as so many are now trying to do, give anxious thought to its exercise. The power is not actually in the hands of the scientist, though he is deeply interested in its future because he has been and is the occasion of its existence. It may fairly be inferred from experience that the scientist himself will never be a tyrant. His work does not rouse in him the desire to dominate, but rather to assist. Love of accuracy, patience, perseverance, self-denial have been common qualities and necessarily so. These have a place in the general esteem, and therefore have their effect. Most of all the world respects the devotion to service that has so often been found; the warm love of their fellows which has inspired so many to give themselves and their labor without counting the return. We must hope that such a spirit will continue in ourselves, whether as individuals or as societies.

The problems of society and in particular those into which natural knowledge enters so powerfully will long demand a patient examination. But whatever may be the tactics that are developed in the end, it is certain that the satisfactory solution will be based upon moral influence. It is for us, as scientists, to supply the natural knowledge and help in its application, but that is not the complete account of what we have to do. Our effectiveness will depend, as is shown by all human history including our own limited experience, upon the devotion, wisdom and good-will which we bring to our task.

SCIENTIFIC EVENTS

THE ZOOLOGICAL SOCIETY OF LONDON

IN a summary of the annual report of the Zoological Society of Great Britain, given in the London *Times*, it is reported that there was a decrease of 130,885, compared with 1937, in the number of visitors to the Zoological Park, London, last year. This is attributed mainly to the September crisis. The total number was 1,816,012. At Whipsnade there was an attendance of 523,345, a decrease of 23,073.

The number of visitors to Regent's Park was the twelfth highest in the history of the society. Admission receipts were £5,628 less than the previous year, and total income amounted to £112,957, a decrease of £12,165. Expenditure was £112,488, a decrease of £5,061, leaving an excess of income over expenditure of £469. Receipts for admission to Whipsnade decreased by £1,077. Income was £33,575, a decrease of £2,421, and expenditure was £27,568, a decrease of £738, giving an excess of income over expenditure of £6,007.

The average strength of the society's collection, excluding aquarium, reptile and insect houses, was 1,035 mammals and 1,846 birds. The animals at Regent's Park consumed 91 tons of hay, 156 tons of clover, 124 tons of horseflesh, nine tons of monkey nuts, 12 tons of bread, 244,649 bananas and 4¼ cwt. of honey.

The aquarium was visited by nearly 15 per cent. of those who entered the gardens. The visitors numbered 283,248, compared with 271,933 in 1937. The increase was largely due to the reduced charge of 6d. on Saturdays, instituted during the year.

In September, it is stated, a scheme was worked out for measures in case of war or other emergency. This involved the conversion of basements into air raid shelters and the removal of valuable books and documents and the families of the staff to Whipsnade.

THE TRANSFER OF DIFFICULT ALPINE PLANTS MADE AT WASHINGTON ARBORETUM

ALTHOUGH the Washington Arboretum at Seattle has been established for less than three years it is producing results that are attracting the attention of both layman and scientist. Thousands of plants have been propagated that are now being placed in permanent locations on the grounds where they will be kept under observation for developments of scientific and educational value.

A significant accomplishment has been the transfer, in one year, of alpine and subalpine plants from their natural altitudes to sea level with no loss of vigor and with no apparent change in character. Three notable instances of successful transfer were *Campanula piperi*, a miniature evergreen member of the Campanulaceae; *Lewisia tweedyi*, the largest and most beautiful of the Lewisia tribe, and *Douglasia dentata*, a rose-colored evergreen member of the Primulaceae. The domestication of these three little known but valuable plants will be a distinct addition to the small list of strictly alpine plants now in use, but the real significance of the accomplishment was that the successful transfer of these difficult plants from altitudes of 7,000 feet or more down to sea level without loss of time was an encouraging indication that in this far western arboretum the development of plant life can be carried to points hitherto unknown.

The Washington Arboretum is situated on the shore of a large inland salt water basin within an area governed by natural phenomena probably without parallel. This enormous inland sea is almost completely enclosed in high, storm-excluding mountain ranges and filled with warm water that flows in from the equatorial streams of the Pacific Ocean. Hygrothermograph charts show a relationship between air and soil temperatures and humidity that is particularly favorable to plant life. The variation in summer and winter atmospheric temperatures is enough to insure plant vigor and hardiness, but is neither extreme enough, nor abrupt enough to retard plant growth.

The presence of conditions unusually favorable to plant life as shown by the natural vegetation has been recognized by scientific men, such as the late Henri Correvon, Reginald Farrar and Dr. E. H. Wilson.

The accomplishments of Washington Arboretum have substantiated their belief that the further development of plants already domesticated and established should be attempted under these conditions.

With a plan of organization similar to the one used at the Arnold Arboretum and the avowed purpose of collecting all reliable information on plant life of educational or scientific value; located on a site of ample size (260 acres) within an area particularly favorable to that purpose; under the scientific supervision of Dean Hugo Winkenwerder, of the School of Forestry of the University of Washington; supported by the Washington Arboretum Foundation, Dr. E. Weldon Young, president; with the cooperation of the Board of Park Commissioners of Seattle and the United States Federal Government, this latest addition to the facilities for scientific research should become one of the leading institutions of its kind in the world.

J. B. F.

DEVELOPMENTS IN ENGINEERING AT CORNELL UNIVERSITY

RAYMOND F. HOWES, assistant to the dean of the College of Engineering of Cornell University, writes that the appointment of Dr. William Abbett Lewis, Jr., of the Westinghouse Electric and Manufacturing Company, as director of the School of Electrical Engineering at Cornell University, which took effect on February 1, completes the reorganization of the administrative staff of the College of Engineering, begun in November, 1937, with the appointment of Professor S. C. Hollister as dean. To succeed Dean Hollister as director of the School of Civil Engineering, Dr. W. Lindsay Malcolm, formerly lieutenant-colonel of Canadian Engineers, was secured from Queens University. Professor William N. Barnard, long head of the Department of Heat-Power Engineering at Cornell, was made director of the Sibley School of Mechanical Engineering; and with the establishment of the School of Chemical Engineering on July 1, 1938, Dr. F. H. Rhodes, professor of industrial chemistry in charge of the former chemical engineering curriculum, became director.

Since the new school has been added to the college and new administrative officers selected for the other three schools, the curve of enrolment has started upward once more, numerous improvements have been made in facilities for instruction and research, and plans have been announced by President Edmund E. Day and the Board of Trustees for a $6,000,000 program to strengthen the college's resources by increasing endowment for instruction and research and constructing the first two units of a proposed new physical plant. A trustee committee, of which Bancroft Gherardi, retired vice-president and chief engineer of the American Telephone and Telegraph Company, is chairman, and the new provost, H. Wallace Peters, is executive secretary, is raising funds for the project.

While waiting for tangible results from this long-range program, the college is constantly improving existing facilities. During the last few months two floors of Sibley Dome have been entirely remodeled. With the Mechanical Engineering Library moved to the second floor, the first has been used to concentrate administrative offices, making available additional classroom space in East Sibley. Faculty offices have also been remodeled in the Mechanical Laboratory buildings, and changes and additions made in equipment. The material testing laboratory has a new 200,000 lb. tension-compression machine, and is installing two smaller machines. Regrouped on a new concrete floor are other machines for tension-compression, torsion, transverse bending, impact and various other standard tests.

New apparatus has also been added to the photo-elastic laboratory, and a constant-temperature room for heat-transfer tests, humidity control and various other types of research in air-conditioning and related fields is under construction. A micromotion laboratory, with moving-picture cameras and projectors and other apparatus for time and motion studies of industrial operations, has recently been completed.

In the School of Civil Engineering, the sanitary and photo-elastic laboratories have made important additions to equipment, as has the material testing laboratory. A graduate students' shop for the construction of special apparatus needed for research and a new computing room have been completed. The School of Electrical Engineering has also added modern equipment for demonstration and research, especially in the field of high-voltage transmission.

THE ANNUAL REPORT OF THE BROOKLYN BOTANIC GARDEN

THE twenty-eighth annual report of the Brooklyn Botanic Garden for the year 1938, just published, calls attention to the fact that during the past year citizens of Brooklyn contributed to the garden for current expenses and permanent improvements more than $54,000. This amount is 57 per cent. of the tax budget appropriation of the city for the support of the garden, and is in addition to private funds, income from endowment and other funds. The private funds budget of the garden was more than 56 per cent. of the total operating budget, the tax budget appropriation being approximately 44 per cent. The City of New York, therefore, derived more than two dollars' worth of return for every dollar appropriated to the Botanic Garden. The attendance at the garden was more than 1,628,000. The record attendance on May 1 of 56,145 was equivalent to 155 visitors every two minutes.

The report records 265 gifts of funds, plants, publications and other objects. The need of additional endowment is stressed by the director. This has become especially urgent since the income from permanent funds and contributions of private funds have fallen off so greatly since 1930, necessitating drastic reduction in the services which the garden renders to the public and to the advancement of science and education. Eighteen pages of the report are devoted to recording the results of scientific research on plant life done at the garden during 1938. These include studies in disease resistance in plants, on the iris and its diseases, on the classification of various groups of flowering plants, on variation in the ferns and studies of economic plants.

The extent to which the garden cooperates with the schools of New York City may be realized in part from the statement that during 1938 more than 150,000 pupils were assisted in their studies through material supplied by the garden, more than 925,000 packets of seed were supplied to school children and more than 24,000 pupils enjoyed plants raised in the garden and placed in schoolrooms.

Under the heading "Free Education," attention is called to the failure of the public to realize that all the so-called "free" educational and recreational privileges which they enjoy through the "free" museums, botanic gardens and other semi-public institutions of the city must be paid for by some one, and there is really no such thing as "free" education. Part of the cost is met by the taxpayers through the tax budget, and a substantial portion of it is met by private citizens who "in addition to their taxes make generous contributions for the support of our public educational institutions." It is pointed out that "it would be salutary if some way could be devised to make every one conscious of this fact who visits our museums, zoological parks and botanic gardens that are open 'free' every day in the year, and who attends their lectures and classes without payment of any fee. Such an opportunity costs money."

SYMPOSIUM ON THE CELL AND PROTOPLASM

DIRECTLY following the meeting of the Pacific Division of the American Association for the Advancement of Science at Stanford University, a symposium will be held in commemoration of the centenary of the cell and protoplasm, opening on June 30 and continuing through July 5.

Papers to be presented, one each forenoon, afternoon and evening, will recognize the comparable development of particulate concepts in both the biological and physical sciences since the beginning of the nineteenth century and will discuss, in view of this development and of its converging trends, some recent investigations in the fields represented. Accordingly both biologists and physicists have been invited to participate.

It is intended that the three papers scheduled for Wednesday, July 5, will link this symposium with the National Colloid Symposium, which convenes also at Stanford University on July 6.

The program of papers on the cell and protoplasm follows:

Friday evening, June 30. "Cell and Protoplasm Concepts: Historical Account," E. G. Conklin, Princeton University.

Saturday, July 1. "The Microdissection of Living Cells" (illustrated), Robert Chambers, New York University. "The Cell Wall and Protoplasm," L. H. Bailey, Harvard University. "Chromosomes and Cytoplasm in Protozoa," H. S. Jennings, the Johns Hopkins University.

Sunday, July 2. "Genes and Chromosomes," Richard Goldschmidt, University of California. "Cellular Differentiation and External Environment," C. M. Child, University of Chicago and Stanford University. "Cellular Differentiation and Internal Environment," R. G. Harrison, Yale University.

Monday, July 3. "Cell and Organism," C. A. Kofoid, University of California. "Chemical Aspects of Microorganisms," C. B. van Niel, Hopkins Marine Station. "Viruses," W. M. Stanley, Rockefeller Institute.

Tuesday, July 4. "Enzymes," H. Theorell, University of Stockholm. "Plant Hormones," F. W. Went, California Institute of Technology. "Vitamines," A. Szent-Györgyi, University of Szeged.

Wednesday, July 5. "Molecular Structure of Protoplasm," O. L. Sponsler, University of California at Los

Angeles. "Protoplasm and Colloids," L. V. Heilbrunn, University of Pennsylvania. "Structural Units," J. D. Bernal, University of London.

THE AMERICAN ACADEMY OF ARTS AND SCIENCES

THE annual meeting of the American Academy of Arts and Sciences was held at its house at 28 Newbury Street, Boston, on May 10. At this meeting it was voted to award the Rumford Medals to Professor George Russell Harrison, professor of physics and director of the Research Laboratory of Experimental Physics at the Massachusetts Institute of Technology, in recognition of his notable work in spectrum photometry and spectrum analysis. Professor Harrison is the thirty-ninth person to receive the Rumford Premium, which was established by a gift to the academy in 1796 from Sir Benjamin Thompson, Count Rumford. By the terms of the gift the medals are to be awarded "to the author of any important invention or useful improvement in heat or light."

The meeting was addressed by Professor August Krogh, head of the department of animal physiology of the University of Copenhagen. Dr. Krogh is a foreign honorary member of the academy and the recipient in 1920 of the Nobel prize in physiology and medicine.

Thirty-three new fellows and seven foreign honorary members were elected, the following being added to the scientific sections of the academy:

FELLOWS

Mathematical and Physical Sciences:

Bart Jan Bok, Harvard College Observatory.
Lyman James Briggs, the National Bureau of Standards.
Harry Edward Farnsworth, Brown University.
Clifford Burrough Purves, Massachusetts Institute of Technology.
C. Richard Soderberg, Massachusetts Institute of Technology.
Frank Clifford Whitmore, Pennsylvania State College.

Natural and Physiological Sciences:

Gregory Pincus, Clark University.
Arturo Rosenblueth, Harvard Medical School.
Frederick Fuller Russell, Brookline.
William Thomas Salter, Harvard Medical School.

FOREIGN HONORARY MEMBERS

Sir Aldo Castellani, London School of Tropical Medicine.
Arnaud Denjoy, professor of mathematics, University of Paris.

The officers elected for the year 1939–1940 were:

President, Harlow Shapley.
Vice-president for Class I, James Flack Norris.
Vice-president for Class II, Walter Bradford Cannon.
Vice-president for Class III, George Grafton Wilson.
Vice-president for Class IV, Arthur Stanley Pease.
Corresponding Secretary, Leigh Hoadley.
Recording Secretary, Hudson Hoagland.
Treasurer, Horace Sayford Ford.
Librarian, Hervey Woodburn Shimer.
Editor, Charles Henry Blake.

RECENT DEATHS AND MEMORIALS

DR. ALEXANDER LAMBERT, professor of clinical medicine at the Cornell University Medical College, from 1898 to 1932, died on May 9 at the age of seventy-seven years. He was a brother of Dr. Samuel W. Lambert, dean emeritus of the College of Physicians and Surgeons of Columbia University, and of Adrian V. S. Lambert, professor of clinical surgery at Columbia University.

DR. W. CRAMP, professor of engineering in the University of Birmingham, England, died on April 20 at the age of sixty-three years.

RUDOLPH BLASCHKA, German artist in glass, maker for more than fifty years of the glass flowers of the Harvard University Museum, died on May 1 at the age of eighty-two years. Mr. Blaschka was compelled to cease work on account of ill health some time ago.

A FUND is being raised at the Rensselaer Polytechnic Institute to found a William Pitt Mason fellowship in chemical engineering and a William Pitt Mason annual prize for the best senior thesis in chemistry. Dr. Frederick W. Schwartz, professor of analytical chemistry at the institute, has asked all former students of Dr. Mason to aid in establishing a fund of $17,500. Dr. Mason retired as head of the department of chemical engineering and chemistry in 1925, after he had served as a member of the faculty for fifty years.

TUESDAY, April 25, 1939, marked the hundredth anniversary of the birth of Thomas Jonathan Burrill. In commemoration of this occasion, graduate students and members of the various departments at the University of Illinois which had their origin in Professor Burrill's early leadership met with the seminar of the department of botany to listen to an address by Professor J. C. Blair, dean of the College of Agriculture and head of the department of horticulture. Dr. Burrill was at one time professor of botany, horticulture and entomology. He was professor of botany and horticulture (until 1903) and remained head of the department of botany until his retirement in 1913. Our correspondent writes: "He was known for his early work in microscopy and bacteriology, and was probably the first person in this country to introduce the use of microscopes in laboratory instruction. He is generally recognized as the first to demonstrate (in 1879) that a plant disease may be due to bacteria."

MRS. MCKINLEY has given the medical library of Earl Baldwin McKinley, who lost his life on the Hawaii Clipper last summer, to the Leonard Wood Memorial (American Leprosy Foundation). This gift has been accepted with deep appreciation by the Medical Advisory Board and the Board of Trustees of the foundation and is to be placed in the Culion Library at Culion, Philippine Islands. The collection will constitute the "Earl Baldwin McKinley Memorial Library." The Leonard Wood Memorial plans to keep the library active by subscribing for the various journals which are now included in it.

SCIENTIFIC NOTES AND NEWS

SIR WILLIAM BRAGG, who came to the United States to deliver the Pilgrim Trust Lecture before the National Academy of Sciences, returned to England on *The Washington* on May 17. The lecture is printed in the present issue of SCIENCE.

A FEW days after the death on January 26 of Professor Albert Sauveur, emeritus professor of metallurgy and metallography at Harvard University, the Association des Ingénieurs, Sortis de l'Ecole de Liége, where Dr. Sauveur studied before coming to America, voted to award to him the Trasenster Medal in recognition of his work in the field of metallurgy and metallography. On learning of his death the association decided to confer posthumously on Dr. Sauveur the medal and the accompanying diploma.

THE E. J. Fox Medal of the Institute of British Foundrymen will be awarded to H. A. Schwartz, manager of research of the National Malleable and Steel Castings Company and professorial lecturer in metallurgy at the Case School of Applied Science, Cleveland, "for his contribution to the manufacture of malleable castings." This is the first time the medal has been awarded to any one outside of Great Britain.

IT is reported in *Nature* that the Makdougall-Brisbane prize of the Royal Society of Edinburgh for 1934 to 1938 has been awarded to Professor D. M. S. Watson for his paper published in the *Transactions* of the society, entitled "On *Rhamphodopsis*, a Ptyctodont from the Middle Old Red Sandstone of Scotland," and for his many distinguished contributions to the science of vertebrate paleontology.

DR. A. E. KENNELLY, professor emeritus of electrical engineering of Harvard University and at the Massachusetts Institute of Technology, was elected on April 14 a member of the Royal Academy of Sciences of Upsala, Sweden.

AMONG honorary degrees to be conferred at the commencement exercises in June of the University of Wisconsin is the doctorate of engineering on Roy C. Muir, engineer and executive of the General Electric Company.

DR. G. GREY TURNER, professor of surgery at the University of London and director of the department of surgery at the British Post-Graduate Hospital and Medical School, will receive on June 21 the honorary degree of doctor of laws from the University of Glasgow.

THE University of Aberdeen has conferred the doctorate of laws on Dr. James McIntosh, director of the Bland-Sutton Institute of Pathology, Middlesex Hospital, London, and on Dr. James Gray, professor of zoology at the University of Cambridge.

DR. CARL SUMNER KNOPF, archeologist and dean of the School of Religion at the University of Southern California, has been elected president of the Academy of Sciences of Southern California; Dr. Howard R. Hill first vice-president; Dr. William A. Bryan second vice-president, and Dr. John A. Comstock secretary-treasurer.

DR. WALTER L. OBOLD, associate professor of biochemistry at the Drexel Institute of Technology, Philadelphia, has been elected chairman of the Pennsylvania Section of the American Institute of Chemists. Other officers elected for the coming year are Dr. Addison C. Angus, of the Philadelphia Clinical Laboratories, *vice-president*, and Dr. Harry C. Winter, of the Biochemical Research Foundation of the Franklin Institute, *secretary*.

DR. WARREN P. TUFTS, head of the division of pomology of the College of Agriculture of the University of California at Davis, has been made chairman of the newly organized Western Section of the American Society for Horticultural Science.

NATIONAL officers to serve during the triennium 1939–41 were recently elected by Phi Lambda Upsilon as follows: *President*, Dr. W. M. Sandstrom, associate professor of agricultural biochemistry at the University of Minnesota; *Vice-president*, Dr. W. T. Read, dean of the School of Chemistry at Rutgers University; *Secretary-treasurer*, Dr. T. F. Buehrer, professor of agricultural chemistry at the University of Arizona; *Editor of The Register*, Dr. L. F. Audrieth, assistant professor of inorganic chemistry at the University of Illinois.

DR. WILLIAM H. TALIAFERRO, dean of the Division of Biological Sciences and professor of parasitology at the University of Chicago, has been appointed to the Eliakim H. Moore distinguished service professorship.

Dr. Paul Leslie Hoover, of Rutgers University, has been appointed professor of electrical engineering and head of the department at the Case School of Applied Science, Cleveland. He will assume active work on July 1, when Professor Henry B. Dates, who has been a member of the faculty for thirty-four years, will retire from active service with the title of professor emeritus.

Dr. Chester H. Forsyth has been promoted to a full professorship of mathematics at Dartmouth College.

Professor C. P. Oliver, of the department of zoology of the University of Minnesota, and Professor L. M. Winters, of the division of animal husbandry at University Farm, will represent the university at the seventh International Congress of Genetics to be held in Edinburgh next August.

Dr. H. H. Love, professor of plant breeding at Cornell University, is spending the months of May and June at the Agricultural Experiment Station of the University of Puerto Rico. He has been invited by the director of the station, Dr. J. A. B. Nolla, to advise with the staff regarding research projects. Dr. Love has done similar work in Hawaii, China and several centers in the United States.

Donald B. MacMillan will sail on June 24 on the schooner *Bowdoin* from Boothbay Harbor, Me., on a scientific expedition to Labrador, North Greenland and Baffin Land. Nine college students, who will work in ornithology, botany, geology and glaciology, will accompany the expedition. The *Bowdoin* will carry supplies to the MacMillan-Moravian School of forty Eskimo children at Nain, Labrador.

Dr. Margaret Mead, assistant curator of ethnology of the American Museum of Natural History, has returned to the United States after spending three years of ethnological research in Bali and New Guinea.

Recent visitors to the School of Tropical Medicine at Puerto Rico were Dr. James W. Jobling, of the department of pathology of the College of Physicians and Surgeons, who represented Columbia University at the annual meeting of the board on April 26, and R. G. Stone, of the Blue Hill Meteorological Observatory of Harvard University, who has been preparing for publication data for the book on the climate of Puerto Rico, left in manuscript by the late Dr. Oliver L. Fassig.

Professor Pasteur Vallery-Radot, of the Paris Faculty of Medicine, has left for French Equatorial Africa and the Cameroons to study the general organization of native medical services.

Sir William Henry Bragg, president of the Royal Society, London, was the guest speaker on May 15 at a luncheon given at the tenth anniversary meeting of the Acoustical Society of America, which was held in New York City. He spoke on the history of acoustics. Other speakers at the luncheon were Dr. Harvey Fletcher, of the Bell Telephone Laboratories, Professor F. A. Saunders, of Harvard University, and W. Waterfall, of the Celotex Company.

Dr. August Krogh, professor of physiology at the University of Copenhagen, who has been visiting the United States, gave an address on "The Teaching of Physiology" before the American Academy of Arts and Sciences on May 10. He left for Europe on May 13.

Former President Herbert Hoover spoke at the meeting of the alumni of Northwestern University on May 1 on "The Future of Technology." Among other speakers were Dr. Glenn Frank, an alumnus, formerly president of the University of Wisconsin, and Dr. Carl E. Seashore, research professor of psychology at the State University of Iowa.

Dr. Lewis Hill Weed, professor of anatomy and director of the School of Medicine of the Johns Hopkins University, gave on May 17 the first lecture under the Robert J. Terry Lectureship Foundation at the Washington University School of Medicine, St. Louis. His subject was "Anatomy in the Medical Curriculum."

Dr. Hugh S. Taylor, chairman of the department of chemistry of Princeton University, addressed on April 26 the sixteenth annual meeting of the Virginia Chapter of Sigma Xi. He spoke on the "Significance of Speed in Chemistry and Other Sciences." At this meeting seventeen new members recently elected were initiated.

Dr. Roy Waldo Miner, curator of living invertebrates at the American Museum of Natural History, New York City, delivered on May 6 the annual lecture of the University of Cincinnati Chapter of Sigma Xi. The lecture was entitled "On the Bottom of a South Sea Pearl Lagoon."

The two hundred and twenty-eighth regular meeting of the American Physical Society will be held in Princeton, New Jersey, on June 23 and 24. The preliminary arrangements for the meeting include a symposium of invited papers on uranium splitting. The two hundred and twenty-ninth meeting of the society will be held at Stanford University, California, on June 28, 29 and 30. There will be a joint meeting with the Astronomical Society of the Pacific on Thursday afternoon, which will consist of a symposium on "Continuous Absorption in Stellar Atmospheres." On Friday afternoon there will be a symposium and demonstration related to high-frequency electromagnetic waves. On Saturday afternoon a symposium on the use of x-rays in structure determination will be held. Contributed papers will be presented in the mornings.

The seventeenth annual meeting of the American Institute of Chemists was held at the World's Fair, New York, on May 13, under the presidency of Robert J. Moore. A tour of the grounds was conducted by Dr. Gerald Wendt, director of science and education of the World's Fair.

The third international Congress for Microbiologists will be held in New York from September 2 to 9. Officers of the congress are: *President,* Dr. T. H. Rivers, member of the Rockefeller Institute for Medical Research and director of the Rockefeller Hospital; *General secretary,* Dr. M. H. Dawson, associate professor of medicine at the College of Physicians and Surgeons, Columbia University; *General treasurer,* Dr. Kenneth Goodner, associate of the Rockefeller Institute for Medical Research.

Ground was broken on May 11 for a high-voltage laboratory at the National Bureau of Standards, which will carry on studies pertaining to industry and phases of medical science. These will include studies of x-ray apparatus, measurement of electrical energy and the testing of electrical installations.

At the annual meeting of the Special Board of Trustees of the School of Tropical Medicine at San Juan, Puerto Rico, Dr. George W. Bachman, director, announced gifts to the school in the amount of $497,260, of which sum $425,000 were granted by the Puerto Rico Reconstruction Administration for the construction of a new library and a tropical physiology building, and $13,500 were appropriated by the Carnegie Corporation of New York for library development.

The Minnesota Academy of Science held its seventh annual meeting at Macalester College in St. Paul on April 22. A general program was held in the morning, and papers were presented in the Biological, Physical and Science Education Sections in the afternoon. The Junior Academy of Science presented a full program and a series of exhibits and demonstrations. Grants for research from the American Association for the Advancement of Science were made to Dr. Ralph W. Macy, of the College of St. Thomas, and to John Marr, of the University of Minnesota. In the evening, a public lecture by Dr. L. H. Powell, of the St. Paul Institute, introduced the group to the new science museum. Officers for 1939–40 include: *President,* O. T. Walter, Macalester College; *Vice-president,* A. M. Elliott, Bemidji Teachers College; *Secretary-Treasurer,* H. K. Wilson, University of Minnesota; *Councilors,* E. M. Freeman, University of Minnesota; E. T. Tufts, St. Olaf College; H. E. Essex, Mayo Clinic, and L. M. Gould, Carleton College. The 1940 meeting will be held on April 20 at the University of Minnesota.

The annual meeting of the New England Section of the American Society of Plant Physiologists opened at New Haven on May 12. Dr. H. B. Vickery, chief biochemist at the Agricultural Experiment Station, is chairman of the New England Section. The program included technical sessions on Friday afternoon and Saturday morning, and a banquet at the Hotel Garde on Friday night. A special subsection interested in blueberry culture met on Friday afternoon and a forum on teaching methods in plant physiology, arranged by Dr. C. J. Lyon, of Dartmouth College, was held on Saturday morning. After the dinner at the Hotel Garde, Professor G. R. Cowgill, of Yale University, described the experiences of a biochemist in Cuba and Panama.

The formal organization of a Soil Science Society of Florida took place at a meeting held in conjunction with the Florida State Horticultural Society at the Hollywood Beach Hotel, on April 18. Officers of the society elected are: *President,* Dr. R. V. Allison, head of the department of chemistry and soils, Agricultural Experiment Station, University of Florida, Gainesville; *Vice-president,* Dr. Michael Peech, soils chemist, Citrus Experiment Station, Lake Alfred; *Secretary-treasurer,* Richard A. Carrigan, assistant chemist, department of chemistry and soils, Agricultural Experiment Station, University of Florida. These, together with Henry C. Henricksen, Eustis, constitute the executive committee.

The Arnold Arboretum Expedition of 1939 to the Mackenzie basin planned to leave Boston about May 20. The objective for this season will be the South Nahanni River region. The South Nahanni is a tributary of the Liard River and drains the southern portion of the Mackenzie Mountain system. The Mackenzie Mountains are almost unknown botanically, and constitute one of the largest blank spots on the botanical map of Canada. The purpose of the expedition will be to make a representative collection of plants, and to study the local distribution of species and plant communities. It is expected that the results will contribute to an understanding of the major problems of plant distribution in Arctic and Subarctic America. The field party will be in charge of Dr. Hugh M. Raup, of Harvard University, who will collect mainly flowering plants and ferns. His wife, Lucy C. Raup, will collect lichens and mosses. The present journey is the eighth of a series conducted by Dr. and Mrs. Raup in the Mackenzie basin since 1926. It is supported by the Arnold Arboretum and the National Museum of Canada, and by grants from the Milton Fund of Harvard, the American Academy of Arts and Sciences, and the National Academy of Sciences. The party expects to return to Boston during the latter half of September.

THE National Advisory Cancer Council has recommended a grant of $23,000 to the University of California for the clinical investigation of cancer therapy with neutron rays, under the direction of Dr. E. O. Lawrence. It has also recommended a grant of $7,500 to the American College of Surgeons toward continuation of a study of hospitals and clinics for the determination of further needs in order to provide adequate clinical cancer service.

THE will of Dr. William Hallock Park, bacteriologist, formerly director of the Bureau of Laboratories of the New York City Department of Health, set aside his residuary estate to establish and maintain a fellowship fund for research in medicine, clinical work and bacteriological and filterable virus diseases. The fund is to continue in perpetuity and is to be known as the "William Hallock Park Research Fund." Dr. Park died on April 6. The trustees are authorized to accept gifts from other donors to the fund. The committee consists of the dean of the New York University College of Medicine, the dean of the College of Physicians and Surgeons of Columbia University, the dean of the Cornell University Medical College, Dr. Camille K. Cayley and Bela Schick. Dr. Cayley receives a bequest of $20,000 with discretionary power to use part of it for research work in medicine.

G. MATHEWS, an Australian ornithologist living in England, has presented to the Commonwealth for the National Library in Canberra what is believed to be the most valuable collection of books on Australian birds in the world. The library was shipped to Australia in April, and Mr. Matthews will visit Australia for two months in order to assist in setting up the books and arranging the catalogue.

DISCUSSION

THE LUMINESCENCE OF ADHESIVE TAPE

INTEREST in bioluminescence has led me to investigate a number of luminescent phenomena which sometimes have been vaguely referred to as triboluminescence and whose explanation does not seem to be widely understood. Most experimenters have observed the transient greenish luminescence which occurs at the point where electricians or surgeons' or "Scotch" tape is stripped from a roll. With some samples this luminescence may be so bright that it is visible with only partially dark-adapted eyes. The phenomenon can be repeated if the tape is rewound and then restripped and also appears when the sticky sides of the tape are pressed together and then separated. It occurs under cold or hot water since a film of air prevents the immediate wetting of the surface. Rubber cement (grippit) whether holding together two pieces of metal, glass, paper, Cellophane or two different materials gives luminescence when the surfaces are separated.

What is not so well known is that many substances when closely adhering to each other will also luminesce when pulled apart. Films when stripped from glass or metal will give a flash of luminescence, for example, collodion dissolved in ether-alcohol mixtures poured on a glass plate and allowed to dry; also ambroid, or rubber latex in aqueous solution such as is used in making toy rubber balloons. However, dextrin as an adhesive separated in the moist stage does not luminesce.

Collodion films are the most striking luminescent bodies. A film removed from glass can be pressed on the glass and will luminesce when removed a second time. Stroking the collodion with the fingers will also result in luminescence but not if the fingers have been moistened with water. Cellophane does not luminesce when stroked with dry fingers.

It is an old observation that mica sheets give a flash of light when split or when crumpled together. Rubber bands will also flash when snapped, although I have only observed the light in one or two instances as the stretched band returned to the short form.

It is apparent that these phenomena have a decidedly electrical flavor. A sheet of collodion stripped from glass or ebonite has a high negative charge, leaving the glass and ebonite positive. It is attracted to the glass with considerable force and sticks to the hand and other objects. The sign of the charge is easily determined by pith ball experiments.

The explanation of such luminescences appears to be this: whenever two surfaces are separated from each other the capacity diminishes and the voltage rises until a discharge takes place, exciting the surrounding gas to luminesce. It is not possible to prove that mica sheets or tire tape, surgeons' tape or Scotch tape are oppositely charged as a whole when pulled apart, but there are no doubt local positive and negative regions developed, the discharge between them giving rise to luminescence.

That a discharge does actually take place can be readily shown by stripping surgeons' tape or Scotch tape in an atmosphere of 2 to 4 cm Hg pressure of neon gas. Then the luminescence is reddish instead of yellowish. Red luminescence also occurs when two strips of mica are pulled apart or when collodion or ambroid or rubber cement is stripped from glass in a low-pressure neon atmosphere. When black tire tape is stripped in neon, the reddish luminescence is not marked. Possibly we have in this case the quenching of the neon by some unknown volatile constituent of the tire tape, since even n-butyl phthalate, whose vapor pressure compares with that of mercury, contains something that prevents neon luminescence when excited electrically.

The phenomenon is quite similar to the well-known luminescence when mercury is shaken in an exhausted tube. If neon is present the luminescence is reddish. The light in a Torricellian vacuum at the head of a mercury column when carried from room to room was observed by Picard in 1675.

These experiments suggested study of the flashes of light observed when crystals are broken, true triboluminescence, characteristic of either minerals or organic compounds, as when two lumps of sugar are rubbed together. If a crystal is piezoelectric, large potential differences are built up by compression. Rochelle salt crystals, strongly piezoelectric, give an orange luminescence when shaken in a tube with 5 cm of neon but no light when shaken in a tube with air, although a flash of light appears in air when the crystal is broken with a hammer. Sugar crystals (rock candy), also piezoelectric, give orange flashes when crushed in 5 cm of neon. Indeed, a large number of substances which do not luminesce on crushing or rubbing in air give a reddish luminescence if shaken with a steel ball in a glass tube containing 5 cm neon. Such are fragments of pyrex glass, galena, Kieselgur (filtercel No. 503), $KClO_3$ crystals, KCl crystals (some samples of which are said to be triboluminescent in air), chitinous Cypridina shells and silk fragments. The reddish luminescence observed in shaking these materials is undoubtedly due to discharges from tribo- or piezo-electricity. However, when crystals of salicylamid, salophen and uranyl nitrate, markedly triboluminescent in air, are shaken in 5 cm neon, in addition to some orange luminescence, which represents electrical discharge in the neon, the bright greenish or colorless sparks of triboluminescence are still apparent. They are not definitely orange or reddish in color.

In triboluminescence of some crystals we therefore have the possibility of light from electrical discharge in the surrounding gas and in addition the excitation of molecules of the crystals themselves. It is noteworthy that salicylamid, salophen and uranyl nitrate are all markedly fluorescent substances whose molecules are excited by ultra-violet light. The luminescence on stripping tapes covered with rubber cement or the separation of various films from surfaces appears to be due entirely to electrical discharge in the surrounding gas.

It is a pleasure to acknowledge the assistance of Mr. Charles Butt in carrying out these experiments.

E. NEWTON HARVEY

PRINCETON UNIVERSITY

CONSUMPTION OF TEOSINTE SEED BY BIRDS IN GUATEMALA

TEOSINTE (*Euchlaena mexicana*), the wild relative of maize, occurs in Guatemala and Mexico often along fence-rows. Kempton and Popenoe[1] suggested birds as a possible factor in the spread of this grass. During a residence in Guatemala for the purpose of studying the maize agriculture of the Indians for the Carnegie Institution of Washington, the writer undertook observations in most of the teosinte localities of the republic with a view to determining what role, if any, birds might play in the distribution of the plant.

A visit was made to the Jutiapa region in southeastern Guatemala in the month of October, 1937. The teosinte seed proved to be unripe at that time, although in other years the month of October had marked the maturity and almost complete scattering of the seed. The prolonged rainy season of 1937 apparently delayed the ripening of the seed, which reached maturity near the end of the following month. During a second visit to Jutiapa made in this month (November), large numbers of birds were observed in the teosinte growths. Many examples were shot and stomach contents noted, whereby it was shown that several species of birds feed upon teosinte seed. A most remarkable fact brought out by these observations is that the birds do not swallow the entire rachis segments, but first remove the horny outer covering which might prove indigestible. The exact manner in which the birds accomplish the extraction of the inner grain was not observed, but local residents claim that at times one can hear the cracking of the outer shell by the birds. All the birds in whose stomachs the seed was found possess powerful beaks.

Specimens collected in the teosinte fields and sent to Washington for the collections of the U. S. National Museum were identified by Dr. Alexander Wetmore as belonging to the following species: *Passerina cyanea,* indigo bunting; *Guiraca caerulea caerulea,* eastern blue grosbeak; *Guiraca caerulea eurhyncha,* large-billed blue grosbeak; *Aimophila ruficauda,* russet-tailed ground sparrow.

The first two species are winter migrants from the United States, and the ground sparrow is native to Guatemala. The large-billed blue grosbeak, if not native to Guatemala, may be a migrant from farther north in Mexico.

Teosinte seed was found in the stomachs of all birds belonging to the first three species above listed. In the specimens of ground sparrow (*Aimophila*) the stomach contents were not identified with certainty and did not appear to be teosinte seed.

During subsequent collecting of teosinte seed in the region of Jacaltenango and San Antonio Huista in northwestern Guatemala in December of the same year, similar species of birds were observed feeding upon the seed, but here no specimens were collected.

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[1] J. H. Kempton and Wilson Popenoe, *Carnegie Inst. Pub.* No. 483, p. 210, June, 1937.

It is to be remarked that close examination of the intestines of the Jutiapa birds showed that digestion of the seed was complete in every instance and that therefore it is unlikely that these birds are a factor in the distribution of teosinte.

RAYMOND STADELMAN
TODOS SANTOS CUCHUMATÁN,
HUEHUETENANGO, GUATEMALA, C. A.

MULL SOIL UNDER SPRUCE

THE development of the mull type of soil in spruce (-fir) woodlands has always been regarded as an unusual phenomenon. As earthworms are regarded as predominant formers of mull soil, and as earthworms prefer a limy soil, the logical place to look for mull soil under spruce would be over limestone deposits. As these occur extensively in Vermont, spruce tracts over limestones were examined in northeastern Vermont, using the *State Geologist Reports* to locate the limestone beds. A handy indicator of such deposits is the white cedar (*Thuya*). In glaciated country the mineral soil of limestone areas is so impregnated with ground limestone that the original deposits do not have to be close to the surface to influence the fauna and flora dependent on or partial to limy soil.

Throughout the region investigated, many spruce stands occur on former pastures, meadows and fields which have been subsequently abandoned and overgrown with spruce. Such agricultural land over limestone usually harbors earthworms, and these may persist in the soil for at least twenty to thirty years after the spruces have occupied the site. Such stands were not included in the investigation, which was limited to such sites as were so extreme as to have been impossible for agriculture. The following two types of sites fall under this head: (1) land too wet for plowing or pasturage, as swamps and seepage areas, (2) land too steep, as ravine sides. Such sites were invariably found to have mull soil (over limestone) except that the mull soil of the swamps was confined to a narrow strip about the edge of the swamp where the land rises from the dead level characteristic of muck swamps formed by lake filling, etc. Earthworm castings and middens were not always visible on the spruce litter, though perforations usually occurred.

The most favorable areas in Vermont were in the counties of Orleans, Caledonia, Washington and Orange. An area in northern New Hampshire (Coos County) was also found to have mull soil in similar favorable sites. Some of these sites were under large spruces and there were large tree stumps about, showing the land had been under woodland for a long period of time.

Thus it is evident that mull soil under spruce stands is not rare if sought for in situations favorable to earthworms.

ARTHUR PAUL JACOT[1]
NORTHEASTERN FOREST EXPERIMENT STATION,
NEW HAVEN

GRAPTOLITES FROM HIGHGATE, VERMONT

To one who has some acquaintance with the area lying east of Lake Champlain and comprising the northwestern corner of Vermont and adjacent parts of Canada, it is not surprising to note the interest shown in this region by various geologists and advanced students. Welcome progress has been made in the interpretation of the difficult geology involved.

In view of announcements within the last three or four years of the occurrence of graptolites in certain rocks in Highgate Township, Vermont, it seems pertinent, for purpose of record, to call attention to the previous discovery and report of such fossils in Highgate.

In the summer of 1921 the writer found definite graptolite remains in slate beds in the north wall of the gorge of the Missisquoi River at Highgate Falls. Although graptolites are not infrequent in the Ordovician slates along the lake shore in Highgate, such fossils had not been reported prior to 1921 from the belt of dislocated rocks which makes up most of Highgate Township and which lies between the overthrusted younger Trenton and associated beds near the lake, and older rocks at the east in Franklin Township.

Two of the graptolites found at Highgate Falls were tentatively identified by the writer as *Dictyonema*, probably *flabelliforme*, and *Staurograptus dichotomus*, Emmons. These specimens with others were submitted to Dr. R. Ruedemann without reference to the locality at which they were found. Dr. Ruedemann thought that the specimen referred by the writer to *Dictyonema* probably belonged to that genus; but regarded the one compared with *Staurograptus* as probably a young *Dictyonema*, "flattened out in a vertical instead of a lateral direction."[1] At the time these graptolites were reported their probable significance was not appreciated.

Several years later graptolite fragments were found in the same general belt of rocks in Highgate, "about one mile northwest of Highgate Center, Vt." These fragments were referred to Dr. Ruedemann, who described them as belonging to a new species of *Dictyonema*, which he called *Dictyonema schucherti*.[2] A reexamination of the material collected by the writer in 1921 at Highgate Falls has revealed a specimen (plesiotype) conforming to *D. schucherti,* but with the outlines of the thecae in general somewhat better preserved than in the holotype.

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[1] Dr. Jacot died on March 24.

[1] Vermont State Geologist, Thirteenth Report, 1921–22, p. 188.

[2] "The Cambrian of the Upper Mississippi Valley," Part 3, *Bull. Pub. Mus. Milwaukee*, Vol. 12, 1933.

Although somewhat delayed, the recognition of this new species among the graptolite specimens found in 1921 at Highgate Falls will be of interest in correlating the slates in which it was found with other rocks of the immediate region, as well as of service in interpreting the age and structural relations among the rocks in the river gorge at the Falls.

C. E. Gordon

Massachusetts State College

SOCIETIES AND MEETINGS

JOINT SYMPOSIUM OF THE AMERICAN CHEMICAL SOCIETY, THE UNIVERSITY OF WISCONSIN AND THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

A Symposium on the Kinetics of Homogeneous Gas Reactions will be held at Madison, Wis., from June 20 to 22, under the sponsorship of the Division of Physical and Inorganic Chemistry of the American Chemical Society and the University of Wisconsin, with the cooperation of Section C of the American Association for the Advancement of Science.

PROGRAM

Tuesday, June 20
9:00 a.m. to 12:00 m.
George Scatchard, *Presiding*

Everett Gorin, Walter Kauzmann, John Walter and Henry Eyring. "Reactions Involving Hydrogen and the Hydrocarbons."

Eugene P. Wigner. "Some Remarks on the Theory of Reaction Rates."

J. A. Christiansen. "On an Elementary Theory of Intramolecular Reactions."

General Discussion. "Calculation of Activation Energies and Absolute Rates."

2:00 to 5:00 p.m.
Farrington Daniels, *Presiding*

George Scatchard. "The Nature of the Critical Complex and the Effect of Changing Medium on the Rate of Reaction."

K. F. Bonhoeffer, K. H. Geib and O. Reitz. "On the Rate of Ionization in Aqueous Solution of the Carbon-Hydrogen Bond in Aliphatic Compounds."

F. O. Rice and K. F. Herzfeld. "Heats of Activation and the Theory of Free Radicals."

H. A. Taylor and M. Burton. "The Reactions between Methyl Radicals."

General Discussion. "Free Radicals." "Bond Energies."

Wednesday, June 21
9:00 a.m. to 12:00 m.
Harold C. Urey, *Presiding*

O. K. Rice and Hallock C. Campbell. "The Explosion of Ethyl Azide in the Presence of Diethyl Ether."

Guenther von Elbe and Bernard Lewis. "Mechanisms of Complex Reactions and the Association of H and O_2."

R. H. Crist and J. E. Wertz. "Kinetics of the Oxidation of Hydrogen Sensitized by Nitrogen Dioxide."

General Discussion. "Explosions."

2:00 to 5:00 p.m.
S. C. Lind, *Presiding*

G. B. Kistiakowsky and W. W. Ransom. "The Polymerization of Gaseous Butadiene."

Richard A. Ogg, Jr., and W. J. Priest. "Kinetics of the Vapor Phase Reaction of Cyclopropane with Iodine."

Robert N. Pease. "The Experimental Basis for the Theory of Quasi-Unimolecular Reactions."

Farrington Daniels and Preston L. Veltman. "The Decomposition of Ethyl Bromide and the Collision Theory of First Order Reactions."

General Discussion. "Collision Theory of Unimolecular Reactions."

Thursday, June 22
9:00 a.m. to 12:00 m.
Philip A. Leighton, *Presiding*

W. Albert Noyes, Jr., and F. C. Henriques, Jr. "Fluorescence and Photochemical Kinetics of Polyatomic Molecules in the Gas Phase."

G. K. Rollefson and D. C. Grahame. "The Effect of Temperature on the Predissociation of Photoactivated Acetaldehyde Molecules."

E. W. R. Steacie and Roger Potvin. "The Cadmium Photosensitized Reactions of Ethane."

S. C. Lind. "Chemical Activation by Gaseous Ionization."

General Discussion. "Photochemical and Ionic Reactions in Gases."

2:00 to 5:00 p.m.
George Scatchard, *Presiding*

On Thursday afternoon the University of Wisconsin will hold a general session devoted to 10-minute papers. Although technical reasons prevent the Division of Physical and Inorganic Chemistry from sharing in sponsoring this session, all those attending the symposium are invited.

This session is planned to accommodate brief reports on work completed too late for inclusion in the preprints. Any one desiring to present a short paper in this field should submit the title and abstract of about 200 words to Farrington Daniels before June 21. The program of papers approved by the committee will be announced on June 21 at the symposium.

The symposium papers will be distributed as preprints before June 1. Together with the discussions they will be published in the *Journal of Chemical Physics*. An attempt will be made to record most of the discussions, but any one may withdraw his discussion from publication.

Chadbourne Hall, one of the university dormitories near the Chemistry Building, will be available for the symposium at rates of $1.50 per day. One floor will be reserved for families. In order to ensure accommodations, those intending to come should make reservations in advance.

Meals will be served in the cafeteria at the Memorial Union on the lake shore. Informal discussions will be continued at noon and in the evenings at the Memorial Union.

The Symposium Committee for the Division of Physical and Inorganic Chemistry is composed of E. J. Cohn, Farrington Daniels, H. Eyring, J. H. Hildebrand, L. S. Kassel, C. A. Kraus, V. K. LaMer, P. A. Leighton, S. C. Lind and G. Scatchard. The committee for the University of Wisconsin is composed of Farrington Daniels, J. O. Hirschfelder, W. E. Roseveare and J. E. Willard.

An informal dinner and launch ride are planned for the early evening on Tuesday and Wednesday.

HAROLD C. UREY,
Secretary

SPECIAL ARTICLES

THE SYNTHESIS OF A POLYSACCHARIDE FROM GLUCOSE-1-PHOSPHATE IN MUSCLE EXTRACT[1]

IT has been shown in previous papers[2, 3] that dialyzed extracts of muscle, heart, liver, brain and yeast contain a phosphorylating enzyme which catalyzes the reaction

glycogen + H_3PO_4 → glucose-1-phosphate (1).

Glycogen is esterified with inorganic phosphate on carbon atom one of each glucose unit. The entire molecule is thereby disrupted into uniform fragments which consist of glucose-1-phosphate. Reaction (1) does not occur unless a small amount of adenylic acid (1 mM) is added to the dialyzed extracts.[4]

Another enzyme which is present in the extracts catalyzes the reaction

glucose-1- → glucose-6-phosphate .. (2).

The migration of the phosphate group is greatly accelerated by Mg^{++} or Mn^{++} ions but takes place also without their addition, so that with time all the 1-ester formed is changed to 6-ester.[5] Attempts to reverse reaction (2) have not been successful, and it became obvious that for a further study of reaction (1) the phosphorylating enzyme had to be separated from the conversion enzyme.

Adsorption with aluminium hydroxide, followed by elution with disodium phosphate, yields an enzyme solution which is rich in phosphorylase and contains relatively little of the conversion enzyme. A second adsorption and elution results in an almost complete separation of the two enzymes. These elutions, after removal of the inorganic phosphate by dialysis, are suitable for a study of reaction (1).

When natural or synthetic 1-ester and 1 mM of adenylic acid are added to these dialyzed elutions, inorganic phosphate is liberated and a polysaccharide is formed. This substance has been isolated by a method similar to that used for the preparation of glycogen from liver or muscle. Without addition of adenylic acid the enzyme remains inactive, showing that adenylic acid is necessary for reaction (1) in both directions. Inosinic or adenosinetriphosphoric acid can not be substituted for adenylic acid. Galactose-1- and mannose-1-phosphate[6] are not transformed into a polysaccharide, and their phosphate group is not split off.

The polysaccharide formed by the muscle enzyme from added 1-ester is not destroyed by heating for one hour in 20 per cent. NaOH at 100°, is insoluble in 50 per cent. alcohol in the presence of electrolytes and does not show measurable reducing power with the alkaline copper reagent of Shaffer and Somogyi. The rate of hydrolysis in 0.2 N HCl at 100° is similar to that of glycogen, and the sugar formed is glucose. When the polysaccharide is added to muscle extract with inorganic phosphate and adenylic acid, it is converted back to the 1-ester. The polysaccharide differs from glycogen by the color it gives with iodine, which is blue. Under certain conditions, particularly after prolonged incubation, the formation of a polysaccharide which gives a purplish-brown color with iodine, can be demonstrated. It is not yet possible to give an explanation for these different color reactions with iodine. Determinations of the molecular weight of the synthetic polysaccharide may offer a clue.

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[1] This work was aided by a research grant from the Rockefeller Foundation.

[2] Cori and Cori, *Proc. Soc. Exp. Biol. and Med.*, 36: 119, 1937; Cori, Colowick and Cori, *Jour. Biol. Chem.*, 121: 465, 1937.

[3] Cori, Colowick and Cori, *Jour. Biol. Chem.*, 123: 375, 1938.

[4] Cori, Colowick and Cori, *Jour. Biol. Chem.*, 123: 381, 1938.

[5] Cori, Colowick and Cori, *Jour. Biol. Chem.*, 124: 543, 1938.

[6] Colowick, *Jour. Biol. Chem.*, 124: 557, 1938.

Fig. 1 shows the general character of the reaction.

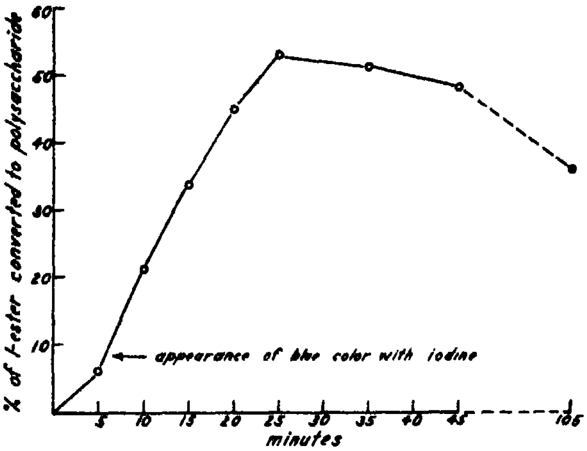

FIG. 1. The reaction mixture consisted of 2.5 cc of enzyme solution and 1.5 cc of additions; it contained 25 mM of synthetic glucose-1-phosphate and 1 mM of adenylic acid and was incubated at 30°. Aliquots of the reaction mixture were removed at the times indicated, deproteinized with trichloroacetic acid and analyzed for inorganic phosphate.

There is a definite lag, followed by a rapid attainment of an equilibrium. During the lag period the reaction mixture remains perfectly clear and the iodine reaction is negative. Often within one minute, the mixture becomes strongly opalescent, and the iodine reaction becomes positive. A liberation of inorganic phosphate occurs simultaneously. Both these points were demonstrated at a meeting of the Missouri branch of the Society for Experimental Biology and Medicine held on April 12, 1939. When the polysaccharide is determined according to Pflueger's method for glycogen, up to 91 per cent. of the calculated amount is found (calculated from the inorganic P liberated simultaneously). If some conversion enzyme is still present, as was the case in the experiment shown in Fig. 1, the reaction is gradually reversed, as shown by disappearance of inorganic phosphate between 25 and 105 minutes. This indicates that one is dealing with a reversible equilibrium.

In a recent note Kiessling[7] states that he has obtained a protein fraction from yeast juice by repeated fractionation with 0.3 saturated ammonium sulfate, which catalyzes reaction (1) in a reversible manner. This protein fraction contains the phosphorylase, the presence of which in yeast has been demonstrated before.[3] According to Kiessling the product formed from 1-ester by the yeast enzyme is a polysaccharide indistinguishable from glycogen. Kiessling's enzyme solutions remained active after prolonged dialysis against 0.3 saturated ammonium sulfate, which he interprets to mean that adenylic acid is not required. It is too early to say whether this indicates a difference between the phosphorylase in muscle and in yeast. An effect of addition of adenylic acid on the yeast phosphorylase could not be demonstrated in this laboratory.[3] It was then believed that the dialysis had not been effective in removing the nucleotide.

The interest of these findings lies in the fact that reaction (1) represents a reversible enzymatic equilibrium and that adenylic acid acts as coenzyme in both directions. Besides, the enzymatic synthesis of a high-molecular polysaccharide from a phosphorylated monosaccharide has been shown to occur *in vitro*. From the physiological point of view it seems important that glucose-1-phosphate has been shown to be the substrate for glycogen synthesis and that the same enzyme—the phosphorylase—brings about glycogen synthesis and glycogenolysis.

The difficulty experienced in obtaining glycogen synthesis in perfused organs or tissue slices is obviously due to the sensitiveness of the mechanism by which glucose is phosphorylated, a process about which nothing is known beyond the fact that oxidative energy is necessary. In yeast extract phosphorylation of glucose occurs anaerobically, linked with the oxidoreduction of cozymase. It is generally assumed that the phosphate is introduced in position 6, since only hexose-6-phosphate has been isolated. If reaction (2) should prove to be irreversible, this phosphorylation would not be the one required for glycogen synthesis.

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[7] Kiessling, *Naturwissenschaften*, 27: 129, 1939; see also Schäffner and Specht, *Naturwissenschaften*, 26: 494, 1938.

THE EFFECT OF ULTRA-VIOLET LIGHT ON BUILT-UP MULTILAYERS

A MULTILAYER of acid barium stearate deposited on chromium-plated steel as a built-up film to a thickness which shows interference colors changes in color after a short exposure to ultra-violet light. Optical measurements show a decrease in apparent thickness of the multilayer.

When glass having a refractive index of n = 1.5 is used as a base, a built-up acid barium stearate film is nearly invisible, since its refractive index is nearly equal to that of glass. Upon irradiation the multilayer becomes visible with bright interference colors having characteristics similar to those of a skeleton film.[1]

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[1] K. B. Blodgett and I. Langmuir, *Phys. Rev.*, 51: 964, 1937.

A film made up of 48 layers, each containing equal parts of stearic acid and barium stearate (referred to as acid barium stearate), placed 25 cm from a quartz high-pressure Hg Uviarc lamp[2] operating at 300 watts, lost optical thickness equivalent to one molecular layer after 5 minutes' irradiation. Without further exposure the film continued to lose optical thickness for several hours, the final loss amounting to more than two layers. A multilayer of pure stearic acid undergoes a similar change in apparent thickness, although it is not skeletonized. Pure barium stearate shows only one twentieth of this loss under the same conditions of irradiation.

The decomposition products formed evaporate completely within ten minutes following five minutes' irradiation if the exposure is made on a film sealed within a highly evacuated quartz tube. In air or an atmosphere of Ar, N_2 or O_2 the change in thickness following irradiation continues for several hours.

By irradiating a film held at 0° C. the photochemical effect can be separated from the subsequent evaporation of the volatile constituent. When this is done the film shows no loss in thickness at the end of 20 minutes of irradiation. With no further exposure it starts to lose thickness as soon as its temperature is raised, and evaporation continues for several hours.

The photochemical effect is produced by a definite region of short-wave radiation and is related to such factors as exposure time, temperature of the film, distance from the source and intensity of the light.

Ozone seems to have little if any effect on the decomposition of the multilayers. A continuous stream of it directed for an hour against a step film produced a slight increase in optical thickness.

The radiations from a Hg arc lamp responsible for most of the photochemical decomposition were of wave-lengths between 2,300 Å and 2,700 Å. This was determined by placing a multilayer at the focal plane of a concave Wood's grating. The light after passing through a narrow slit and falling on the grating 60 cm away was focused as discrete lines on the multilayer. The effective radiation produced visible effects on the multilayer, which after measurement and comparison with the calibrated output of a similar lamp[2] directly established the wave-length region responsible for most of the photochemical decomposition. Twenty-three lines (ranging from 1,949 Å to 3,983 Å) could be seen on the film following six hours of irradiation.

Light of shorter wave-lengths also decomposes acid barium stearate multilayers. A plate bearing a multilayer was sealed in a hot cathode, low-pressure discharge tube and exposed in successive runs to the radiation from Xe, Kr, Ar, Ne and He. The optical loss following each exposure was of the same magnitude. The discharge in 2,000 microns of helium decreased the optical thickness by 16 per cent. in 2 minutes of irradiation. The helium discharge gives a resonant line at 584 Å.

The rate of evaporation of the volatile products formed by irradiation was compared to that of pure straight chain hydrocarbons. Decane, tetradecane and hexadecane were placed successively in a step film of barium stearate which had been skeletonized and the decrease in optical thickness measured as the hydrocarbons evaporated. The evaporation rate of the decomposition product when compared to that of the hydrocarbons showed a rate such as would be expected for heptadecane. This indicates that ultra-violet irradiation splits the molecules of stearic acid at the carboxyl group.

Ultra-violet light passing through a sheet of clear fused quartz coated with 700 layers of acid stearate produces a decrease in thickness which is less than when the light passes through uncoated quartz. This difference measures the absorption of the effective radiation by the acid stearate film. A comparison shows that the absorption due to the 700-layer film reduces the effective radiation by 13 per cent. This indicates an absorption coefficient for the film of 2×10^{-4} per layer.

A similar value is obtained by passing part of the light through a film and observing the reduction in brightness of lines on a fluorescent screen representing radiations from the Hg lamp in the 2,500 Å region. The light was separated into discrete lines by the Wood's grating and focused on a fluorescent screen at the focal plane. A 1,000-layer film showed an absorption per layer of 8×10^{-4} in the region of 1,800 Å which decreased to about 5×10^{-4} at 1,970 Å and 2×10^{-4} at 2,537 Å. At wave-lengths longer than 2,652 Å hardly any absorption was observed.

Irradiation by the Hg lamp of an acid stearate multilayer immersed in distilled water showed a loss after withdrawal of the same order as when irradiated in air. Very little of the decomposition product diffused into the water except after irradiation for ten minutes or more. With films made up of the shorter chain fatty acids, however, containing 14, 15, 16 or 17 carbon atoms the film after a five-minute exposure at 25 cm is partially skeletonized before removal from the water and is found to be strongly hydrophobic when withdrawn.

A paper describing further details of this work will be published in the near future.

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[2] W. E. Forsythe, B. T. Barnes and M. A. Easley, *Jour. Optical Society of America*, 24: 7, 1934.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A METHOD FOR ESTIMATING THE DEGREE OF MINERALIZATION OF BONES FROM TRACINGS OF ROENTGENOGRAMS[1]

FOR an adequate study of skeletal status as a part of a program of research in the field of human nutrition, it is desirable to have a technique for measuring the comparative degrees of mineralization of the bones of living subjects. For this purpose, Sanders,[2] in 1935, began to use a photometric apparatus in which a ray of light was directed through a certain area of a roentgenogram onto a photronic cell in circuit with a voltmeter; the deflection of the voltmeter was compared with that obtained when the light was passed through each of a series of steps of a density ladder on the same roentgenogram. Stein[3] reported use of a photronic apparatus in 1937 and suggested employing density ladders made of ivory for comparative purposes.

The use of a beam of light through a stationary film presents the difficulty of locating comparable bone areas in the roentgenograms of different subjects. To obviate this difficulty, the authors have rebuilt a Type B Moll recording micro-photometer, designed originally for making tracings of spectra, so that it can be used for obtaining tracings from one fixed landmark to another on a roentgenogram. The apparatus as it is now in operation is shown in Fig. 1. The modification of the original apparatus has consisted in substituting a photronic cell for the thermopile originally in the instrument, to obtain greater sensitivity and quicker response; in introducing a means of regulating the current through the light source; in providing for the continuous recharging of a storage battery in the circuit of the light source; and in introducing resistance into the galvanometer circuit sufficient to give critical damping.

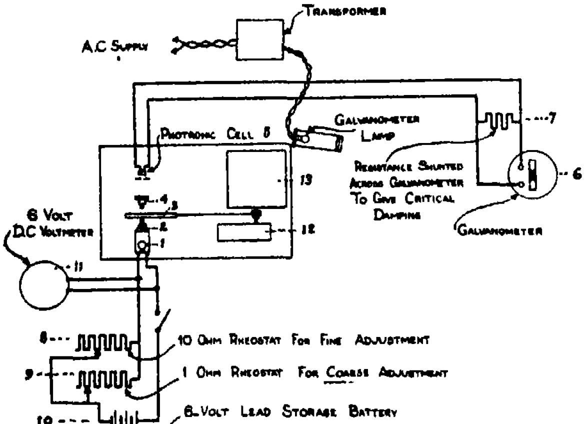
TRANSFORMER
A.C SUPPLY
PHOTRONIC CELL 5
GALVANOMETER LAMP
7
13
RESISTANCE SHUNTED ACROSS GALVANOMETER TO GIVE CRITICAL DAMPING
6
6 VOLT D.C VOLTMETER
4
3
2
1
12
GALVANOMETER
11
8
10 OHM RHEOSTAT FOR FINE ADJUSTMENT
9
1 OHM RHEOSTAT FOR COARSE ADJUSTMENT
10
6-VOLT LEAD STORAGE BATTERY

FIG. 1

In the rebuilt instrument, the light source (1) sends a beam of light through an objective (2) upon the film, which is fixed to the plate-holder (3). The light transmitted passes through a second objective (4) upon a Weston photronic cell (5). The photronic cell is connected with a galvanometer (6) (No. 1136 accompanying microphotometer No. 303, made by Kipp and Zonen, Delft, Holland) in a circuit in which resistance is shunted across the galvanometer to give critical damping (7).

The light source is maintained at constant voltage with a 10-ohm (8) and a 1-ohm (9) resistance in parallel with a 6-volt storage battery (10) in the light circuits, the former resistance for fine and the latter for coarse adjustment. A 6-volt D.C. voltmeter (11) in this circuit permits the voltage to be read. The storage battery is continuously recharged by means of a Retox type trickle charger with a capacity of about one ohm.

In making a tracing, the plate-holder is moved through the stationary beam of light by a spring motor (12), the speed of which is regulated by a magnetic damper. A cylindrical housing (13) encases a drum on which 12 × 40 cm. bromide photographic paper is mounted. A slot in the housing permits a beam of light from the mirror of the galvanometer in the photronic cell circuit to shine upon the photographic paper. The cylinder of the drum around which the photographic paper is secured is rotated by the same spring motor as that which moves the plate-holder; both the plate-holder and the circumference of the drum travel at the same rate.

The instrument as described is being used to make tracings of roentgenograms of both bones and teeth. By measuring with a planimeter the area between a tracing and a base or zero line, and recording the area per unit length of base line in comparison with the area between the tracing of a density ladder and the same length of base line, densities of similar sections of certain bones or teeth of two or more individuals may be compared, comparative densities of different sections of the same bone or of the same tooth may be found, and density values of bones or of teeth in terms of units of a density ladder of known mineral composition may be calculated.

We are indebted to Ernest Axman, instructor in electrical engineering, for invaluable help in adapting the Moll micro-photometer to the purpose in hand.

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[1] Authorized for publication on October 20, 1938, as Paper Number 859 in the Journal Series of the Pennsylvania Agricultural Experiment Station. Authorized August 25, 1938, as Paper Number 3 of the Human Nutrition Series, Division of Home Economics Research, the Pennsylvania State College.

[2] A. Pauline Sanders, Ph.D. Dissertation, the Pennsylvania State College, 1937.

[3] L. Stein, *Am. Jour. Roentgenology and Radium Therapy*, 37: 678–682, 1937.

A THERMOREGULATOR AND RELAY ASSEMBLY[1]

STUDIES on longevity in *Drosophila melanogaster* necessitated the construction of an incubator[2] having a minimum temperature variation. For this reason, it was necessary to construct a temperature control assembly capable of functioning for several months without attention.

Fig. 1 shows the wiring of the incubator. The relay[3] employed was of the repulsion-transformer type having a "Mercoid" contact. In this relay the "Mercoid" element was reversed so that the load line contact would be broken when the pilot circuit was completed by the thermoregulator. The reversal was accomplished by removing the bottom adjusting screw and turning the contact element in its mounting.

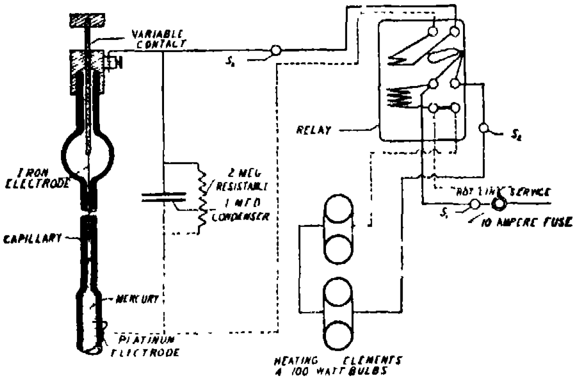

FIG. 1

By bridging the contact points of the thermoregulator with a one microfarad condenser, it was found possible to eliminate much of the spark caused by the "make" of the pilot circuit. It was found, however, that the charge stored on the condenser caused a fairly heavy spark on the "break" of the pilot circuit. A two megohm resistance was inserted as a shunt to dissipate the energy on the condenser. The resistance was high enough not to interfere with the storing of the charge on the condenser, but it allowed the charge to leak off during the time interval between the storing of the charge and the breaking of the contact. The heating elements were put in series, two-by-two, as recommended by Bridges. It was also thought best to protect the complete assembly through a 10-ampere fuse.

The thermoregulator first used was similar to that employed by Bridges. It was found, however, that a film was formed on the inner surface of the capillary after about one week of continuous operation. This threw out of adjustment the setting of the thermoregulator by shorting the regular contact points. To prevent the film formation, 95 per cent. ethyl alcohol, as recommended by Powsner,[4] was substituted for the toluene. This substitution aided, but after a time the film formed again. Analysis showed the film to be an amalgam of the silver from the variable contact. Since iron oxide does not form an amalgam, an iron wire was substituted for the silver electrode.

The temperature was checked every twelve hours during a continuous run of three months, and was found to vary less than ± 0.05° C. At the end of the experiment the thermoregulator was removed and the capillary examined. The only mark on the capillary was a faint black ring just above the contact end of the electrode.

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[1] I am indebted to Mr. Edwin L. Cordes, of the Marquette Physics Department, for helpful suggestions.

[2] C. B. Bridges, *Amer. Nat.*, 66: 250–265, 1932.

[3] The relay is manufactured by The Mercoid Corporation, Chicago, Illinois. The type number is V2–3A.

[4] L. Powsner, *Physiol. Zool.*, 8: 475, 1935.

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ALLEN, GLOVER M. *Bats.* Pp. x + 368. 57 figures. Harvard University Press. $4.00.

CALLOW, A. BARBARA. *Food and Health; an Introduction to the Science of Nutrition.* Second edition. Pp. vi + 168. 9 figures. Oxford University Press. $1.75.

CRUM, ROY W., Editor. *Highway Research Board; Proceedings of the Eighteenth Annual Meeting, Washington, D. C., November–December, 1938; Part I.* Pp. 405. Illustrated. National Research Council, Washington.

FAUNCE, FRANCES A. and FREDERICK G. NICHOLS. *Secretarial Efficiency.* Pp. xii + 601. Illustrated. McGraw-Hill. College edition, $2.75; Trade edition, $3.50.

GARDNER, VICTOR R., FREDERICK C. BRADFORD and HENRY D. HOOKER, JR. *The Fundamentals of Fruit Production.* Second edition. Pp. xvi + 788. 76 figures. McGraw-Hill. $5.00.

Harvey Cushing Society. *A Bibliography of the Writings of Harvey Cushing Prepared on the Occasion of His Seventieth Birthday, April 8, 1939.* Pp. xv + 108. Charles C Thomas. $5.00.

HOLMES, ROGER W. *The Rhyme of Reason; an Invitation to Accurate and Mature Thinking.* Pp. xiv + 516. Illustrated. Appleton-Century. $3.75.

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PARK, ORLANDO, W. C. ALLEE and V. E. SHELFORD. *A Laboratory Introduction to Animal Ecology and Taxonomy.* Pp. x + 271. 17 figures. University of Chicago Press. $2.00.

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

PRELIMINARY ANNOUNCEMENT OF THE MILWAUKEE MEETING

Edited by Dr. F. R. MOULTON

PERMANENT SECRETARY

From June 19 to June 24, inclusive, the association will meet in Milwaukee, Wisconsin. This will be the one hundred fourth meeting of the association, exclusive of the meetings of the Pacific Division and the Southwestern Division. The Southwestern Division from May 3 to May 6 held its nineteenth meeting in connection with the dedication of the McDonald Observatory, near Alpine, Texas. The Pacific Division will meet at Stanford University, California, from June 26 to July 1, inclusive. Thus three meetings of the association will have been held in widely separated parts of the country within two months. The combination of the meeting of the Southwestern with the dedicatory programs of the great new observatory illustrates the possibilities of joint meetings of the association with other organizations to the advantage of science.

The approaching meeting in Milwaukee is the first one held by the association in that city. Milwaukee, with about 650,000 inhabitants, is the twelfth city in population in the United States. It is delightfully situated on the shores of Lake Michigan at the entrance to the summer vacation area of the northern lakes. Milwaukee has many fine hotels and an auditorium building containing several meeting halls with seating capacities ranging from 300 to 8,000. Adequate and excellent accommodations will be available for all persons attending the meeting, and rooms for the sections and affiliated societies will be abundant and conveniently located.

Milwaukee is the home of Marquette University, Milwaukee-Downer College, Milwaukee State Teachers College, Alverno Teachers College, Concordia College, Mount Mary College, Milwaukee Public Museum, an Extension Division of the University of Wisconsin and a notable vocational school. It is a center of education and culture, as well as of industry and commerce. The fact that the association has not heretofore met in Milwaukee has been due to its proximity to Chicago rather than because of any lack of facilities for great meetings or of a lack of interest in science.

HOTELS AND HEADQUARTERS

The general headquarters of the meeting will be in the Hotel Schroeder, which has 850 guest rooms and numerous rooms for scientific sessions. The prices of single rooms, all of which have baths, range from $3.50 to $7.00 per day; double rooms are from $6.00 to $10.00 per day. Other hotels are as follows:

Ambassador: Single, $3.50; double, $5 to $6.
Antlers: Single (no bath), $1.25 to $1.50; double, $3.
Astor: Single, $3.50; double, $6 to $7.
Knickerbocker: Single, $3; double, $5 to $6.
La Salle: Double, $5 to $8.
Martin: Single, $2.50; double, $3.50 to $4.
Medford: Single, $2.50 to $3.00; double, $3.50 to $6.
Pfister: Single, $2.50 to $5; double, $4 to $7.
Plankington: Single, $3 to $4; double, $5 to $8.
Plaza: Double, $3.50 to $4.50.
Shorecrest: Single, $3 to $4; double, $5 to $6.
Tower: Single, $3; double, $4 to $5.
Wisconsin: Single, $3 to $4; double, $4.50 to $7.

The Martin, Medford, Pfister and Wisconsin hotels also have rooms, without baths, at lower rates.

RAILWAY FARES

Regular round-trip railway fares to Milwaukee, including lower Pullman berth from several principal cities in the United States, are as follows: Boston, $78.45; Cleveland, $29.35; Columbus, $27.75; New York City, $70.95; Philadelphia, $64.55; St. Louis, $21.95, and Washington, $61.74.

OFFICIAL MEETINGS

The council of the association will meet on Tuesday, June 20, at 9:00 A.M., in the Hotel Schroeder; thereafter at times to be determined by the council.

GENERAL SESSIONS

On Tuesday evening, June 21, Dr. Victor G. Heiser, distinguished author of "American Doctor's Odyssey," will deliver the eighth Maiben lecture on the subject, "The Influence of Nutrition on the Diseases of Middle and Old Age."

The third of the Science and Society series of conferences, organized by the Section on the Social and Economic Sciences, under the direction of Dr. H. G. Moulton, will consist of five general sessions. The general subject of the conference is, "The Economic System in Relation to Scientific Progress." The first general session will be held at 8:15 on Monday evening, June 19; the second at 4:00 P.M. on Tuesday afternoon; the third on Wednesday at 4 P.M.; the fourth on Thursday evening; and the fifth on Friday evening. For names of speakers and titles of addresses, see program of the Section on Social and Economic Sciences (K) below.

SYMPOSIA

Comprehensive symposia on special fields of science, without reference to the boundaries that ordinarily separate the sciences, are among the most important features of the meetings of the association. Cross fertilization in the realm of ideas, as well as in biological organisms, is productive of vigor and variety.

Section on Chemistry (C). From June 20 to June 22 the section will participate in a symposium on "The Kinetics of Homogeneous Gas Reactions," organized jointly by the Division of Physical and Inorganic Chemistry of the American Chemical Society and the University of Wisconsin. This symposium will be presented at Madison, Wisconsin.

Following a successful research conference at Gibson Island, in Chesapeake Bay, last summer, the section is organizing three special research conferences to be held at the same place this summer. The first will be from June 10 to July 14, inclusive, on "Resinous Polymers"; the second, from July 17 to July 21, on "Vitamins"; and the third, from July 24 to July 28, on "Relation of Structure to Physiological Action." The details of the programs of these conferences will appear the next issue of SCIENCE. They are mentioned here because they are a part of the activities of the section and especially because they are a new type of symposium.

Section on Astronomy (D). The section will hold sessions for papers on Wednesday and Thursday, June 21 and 22, after which a special trip is scheduled to Williams Bay for a visit to the Yerkes Observatory, on invitation of the director, Dr. Otto Struve.

Section on the Zoological Sciences (F). On Tuesday morning, June 20, the section will hold a symposium on "The Relation of Genetics to Geographical Distribution and Speciation," under the chairmanship of Professor L. J. Cole, of the University of Wisconsin.

On Wednesday morning the section will hold a symposium on "Regeneration," under the chairmanship of Professor J. W. Buchanan, of Northwestern University. For details of these symposia see the program of the section below.

Section on the Botanical Sciences (G). On Wednesday morning the section will hold a joint symposium with the Ecological Society of America on "Land Use." A joint symposium with the American Society of Plant Physiologists on "Photoperiodism" is under preparation. Further details are given in connection with the program of the section which follows.

Section on the Social and Economic Sciences (*K*). The section will present two symposia, one of which is the third of the series of conferences on Science and Society, the general title of which is "The Economic System in Relation to Scientific Progress," and the other of which is a symposium, consisting of eight sessions, on population in the Northern Lake States. The symposia are outlined in the program of the section given below.

Section on Engineering (*M*). On Friday, June 23, the section will present a symposium, by arrangement with the Section on Geology and Geography and in cooperation with the American Society of Agricultural Engineers, on soil conservation, especially on those aspects of soil conservation in which engineers and geologists have a share in solving.

Section on Medical Sciences (*N*). On Tuesday afternoon, June 20, all day Wednesday and Thursday morning the section will present a comprehensive symposium on "The Gonococcus and Gonococcal Infection."

On Tuesday morning and afternoon the Sub-section on Pharmacy will present a symposium on "The Vitamins, with Particular Reference to their Standardization." Details are given under the program of the section, which follows.

SECTION AND SOCIETY PROGRAMS

American Meteorological Society. The society, which is affiliated with the Section on Physics, will hold sessions on Monday and Tuesday. In the absence of Robert E. Horton, president of the society, E. J. Misner will preside.

Four papers on hydrology and a sound film on flood weather will be presented at the session on Monday morning. The speakers will be Bertram S. Barnes, LeRoy K. Sherman, N. A. Matson, W. E. Barrow and L. W. Dick. The subjects of the papers are, respectively, "Problems of Stream-Flow Forecasting on Tributaries of the Upper Mississippi," "The Unit Graph," "Flood Frequency and Intensity in the Lacrosse District" and "Lower Ohio *vs.* Upper Ohio Floods."

On Monday afternoon two comprehensive papers will be presented on aerology. Homer W. Ball, of the Weather Bureau Airport Station at Omaha, Nebraska, will discuss "Radiosounding in Omaha"; Arthur W. Marks, Jr., of the Weather Bureau Airport Station at Chicago, will speak on "Airplane Meteorological Flights and Flyers." In addition, a motion picture on "Exploring the Upper Air" will be shown.

The Tuesday morning program will consist of a symposium on radiation. The speakers will be I. F. Hand, Eric R. Miller, Winston M. Manning, and a final paper on "Some Effects of Temperature and Photoperiod upon Plant Growth" will be presented by R. H. Roberts and B. Esther Struckmeyer, of the Department of Horticulture of the University of Wisconsin.

On Tuesday afternoon Charles F. Brooks, director of the Blue Hill Observatory, will deliver an illustrated address on "The New England Hurricane of 1938." Following this address, John G. Albright, of Case School of Applied Science, Cleveland, will present "Some Biographical Notes on the Work of W. C. Redfield and W. Reid on the Rotating Nature of West Indian Hurricanes."

Section on Chemistry (*C*). On Monday, June 19, the section will hold a session in Milwaukee for the presentation of papers and the conducting of a business meeting. From June 20 to June 22 the section will attend the symposium at Madison, Wisconsin, on "The Kinetics of Homogeneous Reactions" given jointly by the Division of Physical and Inorganic Chemistry of the American Chemical Society and the University of Wisconsin. This symposium will consist of from 20 to 30 papers. Among the speakers from abroad will be Drs. Polanyi and Bonhoeffer.

For complete programs of the Special Research Conferences on chemistry to be held at Gibson Island in July, see the next issue of SCIENCE.

Section on Geology and Geography (*E*) *and Affiliated Societies.* With the collaboration of the Geological Society of America and of the Association of American Geographers, Section E will hold sessions on the geology and geography of the Great Lakes region. Although details of the program are still subject to change, it is expected that Monday and Tuesday will be devoted to geologic programs, Wednesday to an all-day field trip, Thursday to geographic papers, and Friday to a meeting with the American Society of Agricultural Engineers for a consideration of soil and land utilization problems in the Great Lakes country.

During the regular week of meetings two all-day field trips will be offered, one on the bedrock geology of eastern Wisconsin, under the leadership of Ira Edwards; another on the glacial geology, under the direction of F. T. Thwaites. Arrangements have also been made with R. M. Dickey for a three-day trip through the copper and iron country of northern Michigan, on June 15, 16, 17, in advance of the sessions at Milwaukee, and with E. F. Bean for a four-day trip to study land utilization problems in Wisconsin, immediately following the indoor meetings devoted to this subject. Advance registration is requested for the longer field excursions, and those interested are asked to communicate with the section secretary (Dr. Howard A. Meyerhoff, Northampton, Mass.) by June 1.

Section on Zoological Sciences (F) and Affiliated Societies. Section F and its affiliated societies will hold scientific sessions on Tuesday, Wednesday and Thursday. Two section symposia of unusual importance have been arranged. On Tuesday morning a symposium on "The Relation of Genetics to Geographical Distribution and Speciation" will be held under the chairmanship of L. J. Cole, of the University of Wisconsin. Included among those who will present important papers on this symposium are: A. H. Sturtevant, California Institute of Technology (Interracial Crossing and Mutation); Carl L. Hubbs, University of Michigan (Speciation in Fishes); M. R. Irwin and R. W. Cumley, University of Wisconsin (Speciation from the Point of View of Genetics); L. R. Dice, University of Michigan (Some Factors in the Geographical Distribution and Speciation of Peromyscus); and Alfred C. Kinsey, Indiana University (The Geographical Distribution of Gall Wasps).

On Wednesday morning a symposium on "Regeneration" will be held under the chairmanship of J. W. Buchanan, of Northwestern University. Included among those who will present important papers on this symposium are: W. C. Curtis, University of Missouri (Histological Basis of Regeneration and Reassociation); L. H. Hyman, American Museum of Natural History (Aspects of Regeneration in Annelids); Olin Rulon, Wayne University (The Environmental Control of Regeneration in Euplanaria); and William Balamuth, University of California (Regeneration in Protozoa: a Study in Morphogenesis).

Section on Botanical Sciences (G) and Affiliated Societies. The sessions of the section will be held on Tuesday, June 20, in joint session with affiliated societies.

A joint symposium with Section F, arranged by L. J. Cole, on "The Relation of Genetics to Geographical Distribution and Speciation" will include as speakers R. E. Cleland, R. W. Cumley, M. R. Irwin and A. H. Sturtevant.

A symposium on "Land Use," which will be held jointly with the Ecological Society of America, has been arranged by Paul B. Sears, including as participants K. C. McMurry, A. Leopold, G. S. Wehrwein and R. Zon.

A symposium on "Photoperiodism," which will be held jointly with the American Society of Plant Physiologists, has been arranged by W. E. Tottingham, with K. C. Hamner, W. F. Loehwing and R. H. Roberts as speakers.

Ecological Society of America. The society will hold sessions on Tuesday, Wednesday and possibly Thursday, June 20 to June 22, inclusive. On Tuesday the society will hold a joint session with the Section on Social and Economic Sciences on "Geographic and Economic Factors Determining the Population Capacity of the Lake States Area." On Wednesday the society will hold a symposium on "Land Use." Among the speakers on this symposium will be Aldo Leopold, K. C. McMurry, George S. Wehrwein and Raphael Zon. On Thursday the society will hold a second joint session with the Section on Social and Economic Sciences. On Thursday, Friday and Saturday members of the society will join with members of the Society of American Foresters in a three-day field trip for observing forest planting, selective logging, salvage logging of cutover areas, and to Forest Service Nursery and the virgin timber and selectively logged area on the Menomonie Indian Reservation. A trip is also being arranged to the Faville Grove Experimental Game Management Area for Friday or Saturday.

Section on Anthropology (H). The section will meet from Tuesday, June 20, to Thursday, June 22, inclusive, at the Milwaukee Public Museum. The central theme of the sessions will be the archeology of the Upper Mississippi area, in which archeologists from Iowa, Illinois, Wisconsin, Michigan, Indiana and Ohio will participate. There will also be discussions of the ethnology and ethno-history of the Indian tribes indigenous to the Great Lakes region. A trip to the Dewey effigy mound group, 24 miles from Milwaukee, is under consideration.

Section on Social and Economic Sciences (K). The program of the section consists of two symposia, two sessions for the presentation of general papers and a luncheon with the Pi Gamma Mu society.

Of the two symposia, one is the third conference in the Science and Society series upon "The Economic System in Relation to Scientific Progress." This symposium consists of five general sessions of the association, the first of which will be held on Monday evening. At this session Dr. George W. Edwards, College of the City of New York, will deliver an address on "The Capitalistic System and How it Evolved," and Dr. Rufus S. Tucker, of the General Motors Corporation, will speak on "Free Enterprise and Scientific Development."

The second session, to be held at 4:00 on Tuesday afternoon, will consist of a paper by Dr. Leo Wolman, National Bureau of Economic Research, on "Impediments to the Operation of the Price, Wage and Profit Mechanism"; and a paper by Dr. Emil Lederer, New School for Social Research, on "Cyclical Fluctuations under the Economic System."

The third session will be held on Wednesday at 4:00 P.M., at which Dr. Charles F. Roos, Cowles Commission for Research in Economics, will present a paper on "The Application of Natural Science Methodology to Economic Studies" and a second paper will discuss "The Limitations of Natural Science Methodology in Economic Analysis."

At the fourth session on Thursday evening Dr. Leverett S. Lyon, the Brookings Institution of Washington, will present a paper on "The Role of Government in the Economic System," and Dr. James W. Bell, Northwestern University, will present a paper on "Government Finance and Economic Stability."

The final session will be held on Friday evening, at which Dr. Charles H. Judd, University of Chicago, will discuss "Present Relations of Government to Science," and Dr. William F. Ogburn, University of Chicago, will present a paper on "Should the Government Finance Non-governmental Research Activities?"

Following the formal papers of each of these discussions opportunity will be given for discussion from the floor.

The second symposium of the section, on population problems and planning in the Northern Lake States area, will consist of eight sessions running through four days, Tuesday, June 20, to Friday, June 23, inclusive.

The two sessions to be held on Tuesday, which are being prepared under the supervision of Professor Stanley D. Dodge, of the University of Michigan, will deal with factors determining the capacity of the Northern Lake States area to support population.

The Wednesday sessions will be devoted to Wisconsin specifically. The morning session will present an outline of the present composition and distribution of the population, in terms of its historical background, migration routes and nationality groups. The afternoon session will be devoted to planning activities of the Wisconsin State Planning Board and of the Northern Lakes States Regional Committee. Among the speakers on this program will be Drs. M. W. Torkelson, George Wehrwein and Samuel Teper.

On Thursday the policies and programs of the Federal Government relative to the area will be reviewed, including land-use planning, agricultural economics and rural resettlement.

The first session on Friday on cultural areas will contain a paper by Dr. A. R. Mangus on "The Regional Approach to American Life," a paper by Dr. Philip Beck on "The Significance of Culture Patterns for Rural Planning Programs," and a paper by George W. Hill on the identification and significance of culture areas in Wisconsin.

The afternoon session on Friday will consist of papers on population mobility. Dr. C. E. Lively will discuss trends of rural-urban migration, Dr. Ray E. Wakeley will discuss the mobility of Iowa farm families, and Dr. J. F. Thaden will present a paper on population mobility in Michigan communities and towns. Dr. R. C. Smith, Farm Security Administration, Indianapolis, will serve as chairman.

A special session will be held on "The Theory of Durable Goods Demand," at which papers will be presented by Drs. C. F. Roos, V. S. von Szeliski, John Kurie and Wendell P. Ayres. At a second session Dr. Horst Mendershausen will present a paper on "Differences in Consumers' Savings between American Communities of Different Size and Location," and Wroe Alderson will present a paper on "Probable Effects of Redistribution of Income upon Changes in Family Status."

Section on Engineering (M). By arrangement with the Section on Geology and Geography, Section on Engineering (M), in cooperation with the American Society of Agricultural Engineers, will hold on Friday, June 23, a joint symposium on various aspects of soil conservation, and especially those aspects of soil conservation in which engineers and geologists have a mutual interest.

Two papers will be presented under the auspices of the Section on Engineering with the cooperation of the American Society of Agricultural Engineers—the first, entitled "Mutual Problems of Conservation—Engineering and Geology," by M. L. Nichols, acting chief of the Division of Research, Soil Conservation Service, U. S. Department of Agriculture; a second paper entitled, "Land Slides in Relation to Agricultural and Engineering Problems," by C. F. Stewart Sharpe, of the Soil Conservation Service of the Department of Agriculture.

The date of the proposed meeting, June 23, follows the annual summer convention of the American Society of Agricultural Engineers which is being held in St. Paul, Minnesota, and it is anticipated that members of the American Society of Agricultural Engineers, following their meeting, will join with those attending the sessions of the Section on Engineering for the conference.

A four-day field trip is in process of organization, to follow immediately after the sessions of the section, plans for which will be made known in detail later.

Section on Medical Sciences (N). The program of the section consists of six sessions beginning on Monday morning and closing on Thursday noon. A group of twenty papers of general interest has been arranged for the two sessions on Monday. They cover such diverse fields as "Potassium Thiocyanate in the Treatment of Hypertension" and "A New Method for the Cultivation of the Pathogenic Trypanosomes."

The outstanding feature of the program of the section will be a symposium on "The Gonococcus and Gonococcal Infection," consisting of four sessions: Tuesday afternoon, Wednesday morning and afternoon and Thursday morning. A total of thirty-three papers by eminent specialists will be presented The titles have been assembled under four headings: I. The Biology of the Gonococcus. II. The Diagnosis of Gonococcal Infection. III. Sulfanilamide and Related Compounds. IV. Therapy and Control. The title of the introductory paper is: "The Problem of Gonococcal Infection," by G. W. Anderson. In the final paper, R. A. Vonderlehr will consider "The Public Health Aspects of Gonococcal Infection."

The Sub-section on Pharmacy. On Tuesday, June 20, the sub-section will present a symposium on vitamins, with special reference to their standardization. In the morning session Aaron Arnold will present a paper on "Vitamin B, Thiamin"; P. H. Phillips, a paper on "Riboflavin"; and C. A. Elvehjem, a paper on "Nicotinic Acid." In the afternoon session W. D. Woolley will read a paper on "Chick Antidermatitis Factor and Vitamin B_6"; A. Black, a paper on "Vitamin A"; and Mrs. F. P. Dann, a paper on Vitamin E.

The Society of American Foresters. The society will hold sessions for the presentation of papers on Monday afternoon, Tuesday morning and afternoon, and Wednesday morning and afternoon. On Thursday the society will take a field trip to Forest Products Laboratory, Madison, and from Friday, June 23, to Sunday, June 25, it will take a field trip to Goodman operations, the Menomonie Indian Reservation and the Nicolet National Forest. An address will be delivered by Robert Goodman.

The program on Monday afternoon, under the chairmanship of C. P. Winslow, consists of an address of welcome by Clarence F. Korstian, president of the society, and four papers by Thomas R. Truax, Mark W. Bray, Arnold O. Benson and Arthur Koehler.

The program on Tuesday morning, under the chairmanship of T. Schantz-Hansen, is on the general topic, "Forest Rehabilitation in the Lake States." Addresses will be delivered by Ray Bassett, H. Basil Wales, Russell N. Cunningham and George Banzhaf. The program on Tuesday afternoon, under the chairmanship of Henry Schmitz, will consist of papers by O. W. Swan, William Heritage, F. H. Eyre and D. M. Matthews. On Tuesday evening the society will hold a banquet, Stanley Wilson, toastmaster.

On Wednesday morning the society will hold a joint symposium with the Ecological Society of America on "Land Use." The four speakers are Aldo Leopold, K. C. McMurry, George S. Wehrwein and Raphael Zon. On Wednesday afternoon the society holds a session, under the chairmanship of W. F. Ramsdell, the speakers on which are Clarence E. Knutson, L. E. Sawyer, J. Alfred Mitchell and P. A. Herbert.

Section on Education (Q). The Section on Education will hold three sessions, Friday morning, June 23, Friday afternoon and Saturday morning, on the general subject, "The Education of the Emotions." At the session on Friday morning, under the chairmanship of A. S. Barr, papers will be presented by Margaret Joseph (Milwaukee), W. Clark Trow (Ann Arbor), H. Meltzer (St. Louis), Robert S. Drews (Detroit), J. L. Kaukonen (Washington) and Benjamin C. Gruenberg (New York City), and Roy C. Bryan (Kalamazoo).

At the Friday afternoon session H. Meltzer will act as chairman and the papers presented will be by O. Irving Jacobson (Alton, Ill.), Kenneth Holland (Washington), Stanford C. Ericksen (University of Arkansas), E. F. Van Buskirk (Stephens College, Columbia, Mo.), Sister Mary Berenice Rice (Catholic University of America, Washington) and Arthur H. Moehlman (Columbus, Ohio).

At the final session on Saturday morning, under the chairmanship of H. H. Remmers, papers will be presented by J. H. Farley (Lawrence College, Appleton, Wis.), E. I. F. Williams (Heidelberg College, Tiffin, Ohio), Leo P. Clements (Creighton University, Omaha, Neb.), Mildred B. Mitchell (Psychopathic Hospital, University of Iowa), F. C. Dana (Iowa State College, Ames, Iowa) and M. Kendig (University of Chicago, Chicago).

SCIENCE VERSUS UNEMPLOYMENT[1]

By Dr. ROBERT I. ALLEN
STETSON UNIVERSITY

SOME months ago, President Roosevelt addressed an open letter to Dr. Karl T. Compton, president of the Massachusetts Institute of Technology, and to the heads of other schools of applied science in the United States, the spirit and purpose of which is shown in the following sentences:

> Events of recent years have brought into clearer perspective the social responsibility of engineering. In respect of the impact of science and engineering upon human life—social and economic dislocations as well as advance in productive power—the facts are revealed with distressing clearness in public records of unemployment, bankruptcies and relief.
>
> The design and construction of specific civil engineering works or of instruments for production represent only one part of the responsibility of engineering. It must also consider social processes and problems, and modes of more

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[1] Address of the president of the Florida Academy of Sciences, Rollins College, November 18, 1938.

perfect adjustment to environment, and must cooperate in designing accommodating mechanisms to absorb the shocks of the impact of science.

This raises the question whether the curricula of engineering schools are so balanced as to give coming generations of engineers the vision and flexible technical capacity necessary to meet the full range of engineering responsibility.

I am calling this matter to the attention of educators of high administrative authority in the hope that it may be thoroughly explored in faculty discussions and in meetings of engineering, educational and other pertinent professional associations.

To this communication President Compton made the following reply:

In response to your challenge to educators. . . . I am sure you will be pleased to know that these are already matters to which progressive educators and engineers have been giving most earnest and constructive attention through their schools and professional organizations. To this end, for example, increasing emphasis is being placed upon fundamentals rather than specialties in undergraduate engineering education, and there has been a notable increase in attention to the study of economics and social science.

I can not but wonder why your exhortation has been directed specifically toward engineers, for surely we would agree that similar breadth of knowledge and training is also urgently desirable among business leaders, economists and politicians—as is also thorough training in fundamentals. For example, there is a tendency in some quarters to make science the major scapegoat of our social ills, from which social planners will rescue us. What are the facts?

Just before the advent of the machine age, social planners were devising resettlement projects and model industrial communities based upon a scheme to employ labor of all children above the age of four years. This was their best solution of the desperate struggle of the masses of the people for the bare necessities of life. Since that time science and engineering have so increased productive power that it has been possible for enlightened public leaders to inaugurate a great program of social security, including child labor laws, universal education, moderate hours of labor, pensions, insurance and unemployment relief on a large scale. These are superimposed on an enormously improved general standard of comfort, health and interest in living. Such achievements of science dwarf into insignificance the ''social and economic dislocations'' to which you refer, unfortunate as these are and much as these merit the attention which you recommend.

So vital to the interests and welfare of all scientists do I consider the issues raised in these two letters that I am taking advantage of this occasion to pass along for your consideration certain data and conclusions that have come to me during the past several years as a result of a study of the very closely related problem—"The Influence of Science upon Employment."

Time was when there was no such thing as "unemployment." In those pre-scientific days each member of the family shared in the task of defending the home against the ravages of nature, beast and man. Even women and children toiled from dawn to sunset to eke out the bare necessities of existence. Those were also the days when human slavery was prevalent throughout the world; when human suffering was almost universal; when the death rate was frightful and entire families were wiped out by horrible epidemics of disease; when famine and pestilence were considered inevitable; when constant warfare was fierce and cruel in the extreme; when social conditions were at their worst! Go back to 1600 and read Lord Bacon's description of the serious economic and social conflicts of his day; or further back to the days of ancient Egypt and Babylonia and read of the labor unions struggling with hours, wages and "sit-down" strikes, and a social order that reeked with economic and social distress. Such were the conditions of mankind in those "good old days" of employment before modern science stepped in to commence its role of "creating unemployment."

To-day, certain enthusiastic and presumably sincere well-wishers of society are proclaiming that modern science has gone too far in its work; that "technological unemployment" is the direct and immediate cause of the economic, social and moral "muddle" in which the world apparently admits itself to be; and that politics, economics and sociology are at present unable to cope with the problems which technology has presented. The more rabid of these critics would have us believe that scientists have created a new world for which man is at present unadapted, and unless science enters upon an indefinite *moratorium* civilization may be destroyed. They cite example after example where some machine like the cotton-gin has "displaced" human labor, thus "creating unemployment," with its attendant ills, among a group of people who formerly were trained in a particular type of service.

If the figures of Mr. Harry G. Davis, director of research of the Farm Equipment Institution, are correct, we must agree that the cotton-gin is indeed a monstrous culprit in this regard, for says Mr. Davis:

> If the cotton-gin were eliminated, and the production of cotton maintained at the average of the past 10 years, 37,000,000 people (or ¼ of our entire population) working 8 hours per day for 300 days per year would be required to separate by hand the seed from the cotton lint.

In this connection, we wonder why some one has not proposed the abolition of the steam shovel or even the pick, spade and wheelbarrow in building roads, as the substitution of teaspoons and buckets or even the bare hands would require a vastly greater number of laborers per cubic yard of dirt moved.

But seriously, no intelligent person can deny that science, during the past 150 years, in its innumerable ramifications, has had an effect upon human living second only to religion. Furthermore, no one will deny that frequently the introduction of some scientific principle or application into an established industry brings about a temporary, and sometimes a permanent, displacement of human labor in that particular field. Hence if one, in making his observations, selects a *"microscope"* and focuses it upon these immediate and transitory results, he may get the impression that "the normal effect of applying science to industry was to throw people out of work and impair standards of living." Basically, the fallacy of such arguments and conclusions, as has been suggested by President Frank B. Jewett, of the Bell Telephone Laboratories, "resides in the narrow angle of the lens through which the problem is viewed. It is an angle too narrow both in the *abscissa* of the population as a whole and in the *ordinate* of time."

Since no close-up or "microscopic" view of existing conditions can afford a true picture or fair perspective, let us adopt the *"telescopic"* (*i.e.,* long-range, wide-angle) point of view and thereby try to appraise the whole field of scientific application since the date of James Watt and his steam engine.

During the past 150 years, as a result of fundamental scientific discoveries, numerous new and vast industries and services have been established. Consider a few: automobile, aviation, radio, motion-picture, telephone, electric lighting and power, metallurgy, rayon, textile and refrigeration. Have these in any sense tended to diminish employment? One wonders what the millions of employees in these science-born industries would find to do if they should suddenly be abolished. Where would be the demand for all those bales of cotton, for instance, which the cotton-gin is now helping to provide, or the other raw materials now pouring into these new industries?

The actual results are to be found in the recently published Report of the National Industrial Conference Board, which featured a study of 18 industries which were entirely unknown 50 years ago. Some of their specific findings will be incorporated later in this paper, but let us note, at this point, several general conclusions regarding the entire national employment situation during this 50-year period:

(1) Jobs have multiplied much faster than people. While the population was increasing 118 per cent., the proportion of employed persons in the population increased 191 per cent. (*Note:* the earlier lower figure included a great amount of child labor from which the latter figure is free; furthermore, as Roger Babson recalls, "25 years ago women in homes and boys on farms or in schools were not reported as jobless; whereas to-day they are put down as 'unemployed' and possibly are 'on relief'.")

(2) In 1870 it required only 324 persons out of every 1,000 of population to produce what consumers demanded; in 1930, with the machine predominant, it required 400 persons out of every 1,000.

(3) National income increased from 1899 to 1929 by 423 per cent., and purchasing power rose 140 per cent. in this period. During the period between 1850 and 1933, the per capita wealth of the U. S. jumped from $308 to $3,500; meanwhile the annual earnings per worker were multiplied nearly 5 times, and the working hours per week cut almost in half. Wage rates, annual earnings and purchasing power have steadily increased with the increased use of machinery and the increased energy which machines have made available.

An interesting side-light on the situation is to be found in a (1937) survey of gainful occupations in the Borough of Manhattan, which shows that there are now 4 times as many ways of earning a living as existed a quarter of a century ago. In 1911 there were only 1,800 vocations listed in the city directory, whereas to-day there are nearly 7,500.

Not only has the introduction of technological development almost invariably resulted in a substantial increase in the total number of persons directly or indirectly employed, but also the standard of living has been greatly raised, because of the resulting lowering of costs of production and sale, and the enlargement of demand and consumption. To-day, living conditions for the average citizen are far more luxurious than existed in the household of kings before the advent of the machine age. These improvements have doubtless, in a large measure, been responsible for the extraordinary fact that the total world population has more than doubled during the past 150 years.

Continuing our "telescopic" survey, let us now proceed to analyze the relation between scientific advancement and industrial employment in several typical fields.

AUTOMOBILE

In selecting the automobile we consider it an outstanding example of pure scientific research—a veritable "child of the fundamental and applied science laboratory." It is also noteworthy as a scientific contribution which practically destroyed an old-established (carriage and wagon) industry. Before 1900 less than 1,000,000 individuals were employed in the manufacture and operation of horse-drawn vehicles; including blacksmiths, stable operators, teamsters, harness workers and wagon and buggy builders. A (1936) report places the total number of persons who are dependent directly or indirectly upon the automobile for their livelihood at about 10,000,000—or approximately one person out of every seven now gainfully employed in the United States. A brief contemplation of the numerous allied industries which the development of the automobile has fostered (such as petroleum, rubber, cotton, glass, steel, trucking, repairing and servicing) is sufficient to convince one that these figures are not exaggerated.

Some idea of the enormous demand for raw products by the automobile industry can be gained by reference to the following partial list of requirements by the Ford Motor Company (during 1935):

69,000,000 pounds of cotton.
500,000 bushels of corn.
2,400,000 pounds of linseed oil.
2,500,000 gallons of molasses.
3,200,000 pounds of wool.
1,500,000 square feet of leather.
20,000 hogs for lard oil.
350,000 pounds of mohair.
2,000,000 pounds of soybean oil.

Additional data from the Ford Motor Company show that during this same depression year (1935) four times as many men were employed and five times more wages paid than during prosperity twenty-odd years ago, when machinery was comparatively crude and more hand work was required. In recounting the experience of the Ford Motor Company in judging the effect of machinery on employment, its spokesman, Mr. W. J. Cameron, states:

> It always surprises people to learn that most of the machinery in use is not labor-saving machinery at all. Most of it is labor-creating or labor-serving; it enables men to work at tasks that never would have been attempted otherwise.
>
> One year when the Company spent $4,000,000 for machinery, its employees increased by 20,000 men, and the pay roll by $48,000,000. Another year when the Company spent $9,000,000 for machinery, its employees increased by 40,000 men, and its pay roll by $88,000,000. In another year when the Company invested $10,000,000 in machinery, employment increased by 37,000 men, and the pay roll by $76,000,000. That was the invariable experience—the more machinery, the more men.

Another quotation seems appropriate here—this time from pen of the columnist, John Temple Graves, II:

> The automobile is the machine-age's best answer to those who say that machinery causes unemployment, for it has created infinitely more employment than ever it destroyed. It is the economist's best example of what the principle of competition means, for the competition of motor companies has produced in the modern low-priced automobile the greatest value in all history. It is the philosopher's best bet for that enlargement of individual life which he prescribes, for it has made possible to the average man, through mere pressure of foot against pedal, such commands of space and time as were never his before.

Dare we conjecture for one moment the present-day consequences which might have resulted if, 30 years ago, legal or other forceful steps had been taken to restrain technological development of the automobile on the ground that the carriage and wagon industry might be interfered with?

ELECTRICITY

Sweeping our "wide-angle telescope" toward the second largest new industry created by science—the *electrical*—we find a similar record of achievement in increasing employment and raising standards of living. Time does not permit detailed reference to its many specialized fields (such as: illumination, ignition, power transmission and conversion, television, telegraphy, telephony and radio), so I have selected for a brief consideration two rather restricted applications—the dial telephone and electrical refrigeration—as typical examples in electricity.

DIAL TELEPHONE

Between 1921 and 1930 dial-telephone installations increased from less than 3 per cent. to more than 30 per cent., while the number of operators, which it was feared might eventually disappear, rose from 190,000 to 249,000. Meanwhile, telephone calls had increased more than 100 per cent. and the number of linesmen had practically doubled. Dr. Frank B. Jewett, president of the Bell Telephone Laboratories and vice-president of the American Telegraph and Telephone Company, recently said: "Of my thirty years of industrial research activities I can not find a single instance where a scientific achievement has resulted in a reduction in employment. In nearly every case more work has resulted and there has been a betterment of living conditions to all classes of society."

ELECTRICAL REFRIGERATION

Another by-product of the "electrical-age" is electrical refrigeration. Fifty years ago the manufacture of ice had not attained the status of an industry. About 15 years ago, when the electrical refrigerator began to bar the ice man from America's kitchens, many critics of technological advancement bemoaned his apparent exit from the ranks of the employed. They overlooked the advent of a new industry which was destined to create not only new employment and new purchasing power but also to actually stimulate the demand for ice by influencing the public in becoming "ice conscious." By 1930 the number of ice dealers had increased 237 per cent. over the census of a decade before, and the sales of ice had reached the highest level in history. To date it is estimated that nearly

10,000,000 electric refrigerators have been manufactured. In a recent (1937) *Bulletin* of the National Resources Committee we read: "A comparison of the sales of electric refrigerators since the beginning of the industry in 1920 with the sales of ice boxes over the same period clearly demonstrates that even if the same number of man-hours were necessary to produce each, no technological unemployment could have resulted from the introduction of this development."

PRINTING

Although not classed as a new industry, printing has during the past 40 years become highly mechanized. This has greatly reduced the cost of printing, thereby stimulating an increased demand for books, magazines and newspapers. Despite the vastly increased output per laborer made possible by machinery, the total number of workers in the printing industry has quintupled, and the average annual earnings per person has increased four-fold. This does not include corresponding expansions in related industries and activities, such as lumber, paper, ink, writing, publishing, editing, news and book dealing, and machine manufacturing. The *Monthly Labor Review* cites a typical case, where "one daily journal published 26,000 copies of a 4-page, 6-column paper in 1852, with '40 compositors and a handful of pressmen, fly boys and other labor.' In 1926 the mechanical staff (of the same newspaper) numbered 1,700 of whom 325 were compositors." If the scribes of Paris could have foreseen such possibilities, they would doubtless have been less vigilant in keeping the printing press out of that city so long.

CLERICAL WORK

Even modern business offices have been electrified and mechanized. These mechanical devices, instead of reducing employment among clerical workers, have made possible such large-scale clerical methods that the total number of secretaries, copyists and accountants increased by nearly 400,000 during the past decade. The invasion of the typewriter has not even injured the pen and pencil trade—witness the new business in fountain pens and patent pencils that has arisen. It is doubtful if modern "big business" could continue to function without the aid of such physical equipment as dictaphones, typewriters and adding machines.

STEAM SHOVEL

A "microscopic" appraisal of the influence upon employment of the steam shovel might suggest that thousands of men who formerly dug for a living have now been displaced. But the "telescopic" view will readily reveal the tremendous program of public works, highways and skyscrapers which this iron monster and its twin brother, the crane, have made possible. How many more riveters, steel workers, masons, carpenters, truckers and other laborers this program has required; and how much greater demand for raw materials and other products—since the power shovel opened the way!

TEXTILE

In the days of the spinning wheel and the hand loom, clothing was scarce and expensive. The perfection of power machinery in the textile industry has made possible greater production at lower cost, which in turn so increased the demand that 30 per cent. more workers are making women's clothes to-day than a decade ago, while 15 per cent. more are making men's furnishings. The whole textile industry provided more employment per unit output in January, 1936, than in the same month of 1929, according to the National Industrial Conference Board.

SHOEMAKING

The census of 1900 lists the number of workers in shoe factories of the United States at slightly more than 150,000, with average earnings of about $415 per year. Despite the fact that during the ensuing quarter of a century the shoemaking industry became almost completely mechanized, the number of workers rose to over 200,000, with average earnings of over $1,000 per person. These figures do not take into account the great expansion in the leather and rubber industries resulting from corresponding increase in the sale of shoes. It should also be noted that the 1900 census included nearly 5,000 children under the age of 16 years, each earning about $175 per year. To-day such prostitution of child labor is intolerable.

Time forbids the further enumeration of the many ways in which science, during the past 150 years, has stimulated employment and otherwise promoted better living conditions for humanity.

What has been said is in no sense a contention that there are not problems of adjustment and distribution yet to be worked out. These are indeed serious problems—but they are *solvable.* The same spirit which enabled man to extract nature's secrets from her vast storehouse should likewise enable him to interpret and apply them to beneficent ends. The real need, humanly speaking, is for an extension of the methods of science into fields where it is not now applied. We agree with the eminent British scientist who said: "Modern society does not suffer too much from science—but from the *frustration of science* by the present social order."

In solving these problems the scientist should give greater attention to the social aspects of his work. No longer should we lay ourselves liable to the charge that the average scientist is too engrossed in the "pursuit of truth for truth's sake" to consider the impact of his work upon society. Dr. Einstein emphasizes this when he warns: "It is not enough that you should understand about applied science in order that your work may increase man's blessings. Concern for the man himself and his fate must always form the chief interest of all technical endeavors. Never forget this in the midst of your diagrams and equations."

Thus it becomes the duty and privilege of the scientist of the future, because of his vantage point in viewing and understanding the significance of his own research, to take the initiative in pointing the way to a better social control and distribution of the "gifts of science." The challenge to follow up his work *socially* is a challenge which no progressive scientist can afford to ignore.

SCIENTIFIC EVENTS

THE DARWIN LIBRARY AT DOWN HOUSE

A PROPOSAL has been adopted by the Down House Committee of the British Association and endorsed by the council, to the effect that efforts should be made to accumulate a collection of books and papers relating to Darwin and his times, more representative than that which is at present housed in his former home. The major part of the existing collection consists of Darwin's own library, which belongs to the professor of botany in Cambridge for the time being, and was generously replaced in Down House by Sir Albert Seward during his tenure of that chair, an action confirmed by his successor, Professor F. T. Brooks. For the rest, the number of Darwinian books in the possession of the association is not large; whereas inquiries concerning such books are not infrequently made by visitors and others. It is felt that a collection such as it is now hoped to acquire will prove to be of real value to students and inquirers, as well as of interest to many who visit the house.

The committee's aim is to collect—(a) all biographies of Darwin; (b) contemporary works on Darwinian theories and kindred subjects; further, (c) the collection of Darwin's own publications (books and papers) is not complete, and (d) the committee would gladly receive and preserve contemporary reviews of Darwin's works.

It is believed that members of the association and others may be able and willing to add to the collection by gift. For any such help the committee and the council will be most grateful. Those who may be in a position to offer appropriate books or papers are asked, in the first instance, to communicate particulars thereof to The Secretary, British Association, Down House, Downe, Kent, in order that duplication may be avoided.

STANDARDS OF THE AMERICAN SOCIETY FOR TESTING MATERIALS

MODIFICATIONS are to be made by the American Society for Testing Materials in methods of publishing standard specifications and tests. These changes are to become effective next November.

All the 870 standards of the American Society for Testing Materials are in use in many branches of industry and commerce. Each is available, and will continue to be in separate pamphlet form, and the standards have been issued in triennially published books of standards with an annual volume giving the so-called tentative standards and tests.

The new method of publication will be to issue the standards and tentative standards collectively in one triennial publication, divided into three parts: Part I, Metals; Part II, Non-Metallic Materials—Constructional; and Part III, Non-Metallic Materials—General. Publication of new and revised tentative standards in the annual *Proceedings*, Part I, will be discontinued; the *Proceedings*, including both committee reports and papers (about 1,300 pages double-column format), will be bound in one volume. The publication of the annual "Book of Tentative Standards" will be discontinued entirely. (The November, 1938, edition is thus the last one to be issued.)

In the two years between the triennial publication of the new book, supplements to each of the three parts will be issued, containing revision and new or revised standards and tentative standards for that year. Since these books will be appreciably larger than the present supplements and will have permanent reference value, they will be bound in cloth. The volume on "Methods of Chemical Analysis of Metals" published in 1936 will be continued as a separate publication.

It is provided that the three parts of the triennial publication in 1939 shall be made up as follows:

Part I, Metals.—Ferrous and non-ferrous metals (all A and B and some E serial designations) except methods of chemical analysis. General testing methods (E serial designations).

Part II, Non-metallic Materials—Constructional.—Cementitious materials, concrete and aggregates, masonry building units, ceramics, pipe and tile, thermal insulating materials (all C serial designations). Timber and timber preservatives, paints, varnishes and lacquers, road materials, waterproofing and roofing materials, soils (certain D serial designations). General testing methods, thermometers (E serial designations).

Part III, Non-metallic Materials—General.—Fuels, petroleum products, electrical insulating materials, rubber, textiles, soaps and detergents, paper, plastics, water (remainder of D serial designations). General testing methods, thermometers (E serial designations).

Further details of the plan can be obtained from the headquarters of the society, Philadelphia, Pa., including sales prices for the new "Book of Standards," 1940–41 Supplements and the annual *Proceedings*.

CONFERENCES ON THEORETICAL PHYSICS AND SPECTROSCOPY

THE thirteenth annual symposium on theoretical physics will be held at the University of Michigan from June 26 to August 18. The lecturers and subjects are as follows:

Professor Enrico Fermi, Columbia University
Throughout the Session
"Physics of High Energy Particles."
"Cosmic Rays."

Professor E. J. Williams, University of Wales
July 12 to August 12
"General Discussion of the Theory of Collision."
"Scattering of Fast Electrons and Cosmic Ray Particles."

Professor Gerhard Herzberg, University of Saskatchewan
Throughout the Session
"Band Spectra."

Assistant Professor John A. Wheeler, Princeton University
July 3 to August 12
"The Interaction between Electromagnetic Radiation and the Nucleus."

Dr. G. B. B. M. Sutherland, lecturer in physics, Pembroke College, Cambridge
July 24 to August 5
"Applications of Infra-red Spectra to the Determination of Inter- and Intra-Molecular Forces."

The seventh Conference on Spectroscopy will be held at the George Eastman Research Laboratories of the Massachusetts Institute of Technology on July 17, 18 and 19, repeating the type of program presented at the conferences held during the past six summers. Reports will be given by spectroscopists from university and industrial research and analytical laboratories and by biologists, geologists, metallurgists, chemists and physicists, who have found spectroscopic equipment useful in their investigations.

Morning and afternoon meetings will be held on three days. Papers and discussions on analysis of material by the emission spectrum, absorption spectrophotometry, photographic photometry, biological and chemical effects of spectral radiation and industrial applications of spectroscopy are being prepared. Copies of the detailed program of the conference will be sent on request to any one interested, but as the attendance at the conference is limited to two hundred, those expecting to attend from a distance are urged to signify in advance their intention of being present. No fee is charged in connection with the conference.

The usual summer courses on practical and applied spectroscopy will be offered at the institute between June 12 and July 22. Requests for fuller information regarding the spectroscopy conference, including titles of the papers to be presented, and for data regarding the summer courses should be addressed to Professor George R. Harrison, Massachusetts Institute of Technology, Cambridge, Mass.

BOSTON SOCIETY OF NATURAL HISTORY

AT the annual meeting of the Boston Society of Natural History, held on May 5 at the New England Museum of Natural History, the following officers were elected: *President,* John K. Howard; *Vice-presidents,* Glover M. Allen, Harold L. Babcock and Thomas D. Cabot; *Secretary,* Charles H. Blake; *Treasurer,* Augustus P. Loring, Jr.; *Executive Director,* Bradford Washburn; *Scientific Director,* Edward Wigglesworth; *Trustees,* Thomas Barbour, Charles H. Blake, Arthur Burger, Thornton W. Burgess, Alexander Forbes, Ludlow Griscom, Ralph Hornblower, Carl T. Keller, A. Lawrence Lowell, Alfred C. Redfield and William H. Weston, Jr.

In February Bradford Washburn, of the Institute of Geographical Exploration at Harvard University, took office as executive director of the New England Museum of Natural History. For ten years he has been largely engaged in pioneer exploration of the mountains of Alaska, both on the ground and from the air. He made first ascents of Mounts Lucania, Sanford and Saint Agnes.

Each year the society offers a prize known as the Walker Prize for the best memoir presented in a field of natural history. This year the prize was awarded to Donald R. Griffin, of Harvard University, for his paper on "The Migrations of New England Bats."

The Walker Grand Prize in Natural History, awarded once in five years for meritorious scientific investigation or discovery in natural history, was granted to Dr. John N. Couch, of the University of North Carolina, for his work on the genus *Septobasidium* published in the early spring of 1938.

IN HONOR OF GLOVER MORRILL ALLEN

THE Visiting Committee of the Overseers of Harvard University and the faculty and staff of the Museum of Comparative Zoology gathered on the afternoon of May 5 to do honor to Dr. Glover Morrill Allen. The occasion was to celebrate the appearance, within one year, of three publications of outstanding importance.

1. The first volume of the Mammals of China and Mongolia, being volume 11 of the series entitled Natural History of Central Asia, published by the American Museum of Natural History.

2. The Checklist of African Mammals, being volume 83 of the *Bulletin* of the Museum of Comparative Zoology.

3. Bats, a complete account of the evolution and natural history of the group, published by the Harvard University Press.

Nearly a hundred persons were present. The meeting was presided over by George Russell Agassiz, senior member of the faculty of the museum. President Emeritus A. Lawrence Lowell was present at Mr. Agassiz's side.

Addresses of congratulations were made by the director of the museum, Thomas Barbour, on behalf of the staff; by Sherwood L. Washburn on behalf of Dr. Allen's graduate students; by Professor F. L. Hisaw, speaking for the Division of Biology, and then Harold J. Coolidge, Jr., read a number of letters of congratulation and appreciation which had been received from Dr. Allen's colleagues far and wide.

Dr. Allen was presented with a hammered silver bowl, a replica of one in the Metropolitan Museum of Art in New York, made by Paul Revere. It was suitably inscribed with a statement of the reasons for the presentation. After this Dr. Allen made a brief reply expressing his appreciation.

A humorous broadcast "direct from Africa," which had been prepared with incidental music by a group of Dr. Allen's undergraduate students, was then turned on, and at its conclusion the company adjourned to Mr. Agassiz's room for refreshments.

PRESENTATION OF THE WILLARD GIBBS MEDAL

THE Willard Gibbs Medal of the Chicago Section of the American Chemical Society was presented to Dr. Donald Dexter Van Slyke, chief chemist of the Hospital of the Rockefeller Institute for Medical Research, at a meeting in the Stevens Hotel, Chicago, on May 19.

Dr. Charles A. Kraus, of Brown University, president of the American Chemical Society, made the presentation to Dr. Van Slyke, who was cited for his work on the chemistry of proteins, enzyme action, blood chemistry and the metabolic conditions of diabetes and nephritis. The citation reads:

> The acceleration of interest and of active work in modern quantitative clinical chemistry during the past quarter century is in no small degree attributable to Dr. Van Slyke. The need of the clinic for micro-methods for the analysis of small and readily obtainable samples of blood found in him, always adept at the development of analytic methods, the person ready to make the greatest contributions of his generation to this field.
>
> Dr. Van Slyke is honored for his contributions to chemistry, physiology and medicine. The genius of the medalist lies in his ability to see through a subject, clarify its problems, devise methods for their solution and carry the whole enterprise through to a successful conclusion. His contributions have the virtue of directness, simplicity and elegance combined with a minimum of speculation.
>
> This genius, now recognized by the award of the Willard Gibbs Medal, has previously brought him the honorary degree of Sc.D. from Yale in 1925, and from Michigan, his alma mater, in 1935. In 1938 the University of Oslo conferred upon him the honorary degree of M.D. He was awarded the Mickel fellowship, Toronto, in 1936, and the Philip A. Conne gold medal of the Chemists' Club, New York, in 1937.

Dr. Glenn E. Cullen, of the Children's Hospital Research Foundation, Cincinnati, collaborator with Dr. Van Slyke in researches, spoke on "The Medalist"; Professor Charles D. Hurd, of Northwestern University, chairman of the section, discussed "The Significance of the Willard Gibbs Medal," and Dr. Kraus described "The Life and Works of Willard Gibbs." Dr. Van Slyke, in his address of acceptance, traced the development of controlled oxygen therapy. Howard Vincent O'Brien, of *The Chicago Daily News*, gave the epilogue. Dr. Van Slyke delivered a scientific address on "Renal Mechanisms Controlling Blood Composition" on the following day before members of the section at Northwestern University.

Dr. Van Slyke's fields of work have embraced the chemistry and physiology of the proteins and amino acids, quantitative formulation of the theory of buffer action, demonstration of enzyme action by formation of temporary enzyme-substrate compounds, various phases of physical chemistry of the blood, micromethods for the gases and other constituents of the blood, a system of microanalyses by manometric technique and various diagnostic tests, particularly those for the detection of acidosis in diabetes and of renal failure in Bright's disease.

SCIENTIFIC NOTES AND NEWS

DR. GEORGE DAVID BIRKHOFF, Perkins professor of mathematics at Harvard University, retiring president of the American Association for the Advancement of Science, will retire on September 1 as dean of the faculty of arts and sciences, having filled the allotted three years in the deanship. He will be succeeded by Dr. William Scott Ferguson, McLean professor of ancient and modern history. Dr. Birkhoff has been appointed Harvard exchange professor to France for the second half of the academic year 1939–40.

DR. JAMES B. HERRICK, emeritus professor of medicine at Rush Medical College, Chicago, was awarded at St. Louis the distinguished service medal of the American Medical Association in recognition of his discoveries in connection with heart disease.

The American Association of Clinical Pathologists, meeting in St. Louis, conferred on May 13 its Burdick Award, a gold medal given annually for "outstanding contribution to medical science," upon Dr. Harry Goldblatt, professor of experimental pathology at the School of Medicine and associate director of the Institute of Pathology of Western Reserve University, in recognition of his researches in hypertension and his discoveries of the relationships between high blood pressure and diseases of the kidneys.

At the annual meeting of the American Society of Orthodontists in Kansas City on April 20, Dr. Milo Hellman, professor of dentistry at Columbia University and research associate in physical anthropology at the American Museum of Natural History, was presented with the Ketcham Memorial Award in recognition of his "contributions to the science and art of orthodontia." The award is made annually by the American Board of Orthodontists in memory of the late Albert H. Ketcham, a pioneer in the field of orthodontia.

The Electrochemical Society has awarded the eleventh Weston fellowship of $1,000 to Waldemar P. Ruemmler, of St. Louis. Mr. Ruemmler will continue his research at Columbia University, investigating the electrodeposition of antimony. The work will be done under the direction of Professor Colin G. Fink. The prize to young authors has been awarded to Nathaniel B. Nichols, research associate at the University of Michigan, for a paper published jointly by Dr. L. A. Matheson and Mr. Nichols entitled, "The Cathode Ray Oscillograph Applied to the Dropping Mercury Electrode."

Dr. Nathan B. Van Etten, of New York City, was chosen on May 19 at the St. Louis meeting president-elect of the American Medical Association. He will be inducted into office at the annual convention that will be held in New York City from June 10 to 14, 1940. He succeeds Dr. Rock Sleyster, of Wauwatosa, Wis. Dr. Alphonse McMahon, of St. Louis, was elected vice-president. The house of delegates voted to hold its convention in 1942 in Atlantic City, N. J. The 1941 meeting will be held in Cleveland, Ohio.

At the annual meeting of the American Institute of Nutrition, held in Toronto in April, the following officers were elected: *President,* Henry C. Sherman; *Vice-president,* T. M. Carpenter; *Treasurer,* G. R. Cowgill; *Secretary,* L. A. Maynard; *Councilor,* A. H. Smith. The following were elected to the editorial board as associate editors: Icie Macy Hoobler, H. A. Mattill and H. H. Mitchell.

Dr. Frank Vinsonhaler, dean of the School of Medicine of the University of Arkansas at Little Rock, will retire with the title emeritus on July 1.

Dr. Harold St. John, professor of botany at the University of Hawaii, has been appointed Bishop Museum visiting professor in botany at Yale University for the year 1939–40.

Dr. Normand L. Hoerr, assistant professor of anatomy at the University of Chicago, will be nominated at the annual meeting of the Board of Trustees of Western Reserve University on June 13 as Henry Wilson Payne professor of anatomy and head of the department of anatomy of the School of Medicine, to fill the vacancy left last December by the death of Dr. T. Wingate Todd.

Lieutenant Colonel A. Parker Hitchens, Medical Corps, U. S. A., has been appointed George S. Pepper professor of public health and preventive medicine at the University of Pennsylvania. He will be the head of a new department of the School of Medicine which will carry on work in those fields. Lieutenant Colonel Hitchens, who has devoted much of his life to the problems of public health, has been assistant professor of military science and tactics in the Reserve Officers Training Corps at the university since the opening of the current academic year. His appointment to a professorship in the School of Medicine at Pennsylvania has been made possible by permission from the Secretary of War.

Dr. Leonard H. Pollard, associate in truck crops at the University of California, Davis, was appointed recently head of the department of vegetable crops at the Utah State Agricultural College at Logan.

Dr. Charles H. Rammelkamp, assistant resident in medicine at Barnes Hospital, St. Louis, has been made a research fellow in medicine at the Harvard Medical School and assistant resident in the Thorndike Laboratory of the Boston City Hospital.

Dr. Roger J. Williams, of the Oregon State College, has been appointed a member of the department of biochemistry at the University of Texas.

Dr. Guy F. MacLeod, professor of entomology at Cornell University, has become entomologist in the University of California Agricultural Experiment Station at Berkeley. Dr. E. C. Van Dyke, who has been in charge of systematic work in the division of entomology and parasitology at the University of California, retires on July 1 with the title professor of entomology, emeritus. His work will be carried on by Professor E. O. Essig. Dr. MacLeod will take charge of the work in agricultural entomology, previously conducted by Professor Essig.

Dr. Frank M. Setzler, head curator of anthropology at the U. S. National Museum, has been appointed a member of the Advisory Board on National Parks, Historic Sites, Buildings and Monuments. He succeeds Dr. Alfred V. Kidder, of Cambridge, Mass., who resigned last autumn owing to pressure of other work.

DR. H. W. RICKETT, associate professor of botany at the University of Missouri, has been appointed assistant bibliographer at the New York Botanical Garden. He will assume his new work about July 1.

FRANK C. BAKER, since 1917 curator of the Museum of Natural History of the University of Illinois, will retire from active service on September 1, with the title of curator emeritus. Mr. Baker will remain at the University of Illinois and will continue his work on fresh-water Mollusca and on the invertebrate life of the Pleistocene.

DR. STANLEY D. WILSON, professor of organic chemistry and dean of the College of Natural Sciences at Yenching University, Peiping, China, will spend the year 1939–1940 on furlough in the United States. He will be engaged in study and observation at Harvard University, the Massachusetts Institute of Technology, Rutgers University and the University of Chicago.

DR. GEORGE W. LEWIS, director of research of the National Advisory Committee for Aeronautics and president of the Institute of the Aeronautical Sciences, sailed on May 17 for London, where he will attend the annual meeting of the Royal Aeronautical Society and will deliver the Wilbur Wright Memorial Lecture.

PROFESSOR J. H. VAN VLECK, of Harvard University, is giving a series of lectures at the Institut Henri Poincaré at the University of Paris during the current month. He will also take part in a symposium on magnetism at Strasbourg.

DR. EDMUND V. COWDRY, professor of cytology at the School of Medicine of Washington University, St. Louis, delivered the Woodward lecture at the Sterling Hall of Medicine of Yale University on May 24. His subject was "Problems of Ageing."

DR. LIVINGSTON FARRAND, president emeritus of Cornell University, gave the last of this season's laity lectures at the New York Academy of Medicine on May 15. The title of his lecture was "Primitive Man and Medicine."

DR. HERBERT F. MOORE, professor of engineering materials at the University of Illinois, will give on June 28 the fourteenth Edgar Marburg lecture at the annual meeting in Atlantic City of the American Society for Testing Materials.

THE *Journal* of the American Medical Association states that Dr. Max Cutler, director of the Chicago Tumor Institute, recently returned from a cruise around South America in which he gave nine addresses before medical associations and universities. The Chicago Tumor Institute has granted one fellowship to each of the South American countries for graduate instruction in the field of cancer. They will be selected by the deans of the medical schools and the ministers of health.

ALFRED P. SLOAN, JR., chairman of the Board of General Motors Corporation, will deliver the sixth annual Alexander Van Rensselaer lecture at Drexel Institute of Technology on June 6. His subject will be "A Great Corporation from Within."

DR. AUGUST KROGH, professor and director of the Zoophysiological Laboratory, University of Copenhagen, who has now returned to Europe, delivered the forty-fourth Hanna Lecture at the Institute of Pathology, Cleveland, on May 5. He spoke on "The Regulation of the Circulation as Observed in Changes of Posture in Man."

THE seventh Symposium on Quantitative Biology will be held at the Biological Laboratory, Cold Spring Harbor, Long Island, New York, from June 20 to July 21. Thirty-two papers on "Biological Oxidations" will be presented. Other investigators in the field can take part in the discussions following each paper. A complete program may be obtained from the Biological Laboratory. Those planning to stay over night or longer should make arrangements beforehand with Dr. Eric Ponder, director of the laboratory.

THE annual meeting of the American Society for Testing Materials will be held at Chalfonte-Haddon Hall, Atlantic City, from June 26 to June 30. There will be an exhibit of testing apparatus and related equipment. During the meeting the thirteenth award of the Charles B. Dudley Medal will be made.

AT the University of Colorado Summer School a Conference on the Psychology of Learning will be held in Boulder on August 9, 10 and 11, under the direction of Professor K. F. Muenzinger and Dr. I. Krechevsky, of the department of psychology.

THE ninth annual Research Conference of the Johns Hopkins University is being held at the Henlopen Hotel, Rehoboth Beach, Delaware, from June 5 to 9 and from June 12 to 16. The first week, with Dr. Leslie Hellerman as chairman, will be devoted to biochemistry. Lectures will be included on the Cage Structure of Proteins and on the Use of New Research Tools in Biochemistry, including the ultra-centrifuge, the electron microscope, the Tiselius apparatus, the dropping mercury electrode and isotopes. During the second week a number of lectures and discussions on organic molecules and organic reactions will be presented. Dr. A. H. Corwin will act as chairman. Topics to be discussed are the Friedel-Craft Reaction, Aluminum Chloride in Organic Synthesis, Infra-Red Spectroscopy and the Structure of Organic Molecules, Raman Spectra and Their Application to Organic Molecules, Thermodynamic Data on Organic Reactions, Free Radicals in Organic Reactions and Mechanism Studies on Hydrogenation Catalysis. Further information may be obtained from Dr. P. H. Emmett, the Johns Hopkins University, Baltimore, Md.

MISS MAY MORRIS, of Kelmscott-Manor, Lechlade, daughter of William Morris, poet and artist, who died on October 16, left to the University of Oxford, as a memorial of her father, her Kelmscott estate and certain furniture and effects with £3,000 for its maintenance, for a House of Rest for artists, men of letters, scholars and men of science. She directed that no modern innovations or improvements or installations be made to the house in view of its age and its historic interest as the home of the late William Morris, "as it is in the same condition as when he left it."

AT a recent meeting of the Board of Directors of the Finney-Howell Research Foundation, Baltimore, Md., eight fellowships were renewed and further fellowships for 1939 were awarded as follows: G. M. Badger, of Melbourne, Australia, to work at the Royal Cancer Hospital, London; Dr. Arthur Kirschbaum, to work at Yale University; Dr. J. L. Melnick, to work at Yale University; Dr. John F. Menke, to work at Stanford University Hospital; Dr. John L. Wood, to work at Harvard University; Dr. Paul C. Zanecnik, to work under Dr. K. Linderström-Lang at the University of Carlsberg, Copenhagen. Grants-in-aid were awarded to: Dr. R. D. Fowler and to Dr. R. Walter Graham, Jr., of the Johns Hopkins University, and to Dr. George O. Gey, of the Johns Hopkins School of Medicine. Applications for 1940 awards must be received at the office of the foundation by January 1, 1940.

DISCUSSION

A DILEMMA IN VITAMINS

A HALF century ago the geologists were demanding a hundred million years for the age of the earth, while the astronomers were not willing to concede them more than ten million. Now there seems to be a corresponding situation between the anthropologists and the dietitians with regard to vitamin C.

The position of the dietitians, or at least of a certain school of dietetics, may be taken from the 1938 revised edition of "The Foundations of Nutrition," by Dr. Mary Swartz Rose, and reinforced by quotations which Dr. Rose gives (personal communication) from Dr. Henry Clapp Sherman's "The Vitamins" (in collaboration with S. L. Smith):

> . . . what little (vitamin C) there may be in fresh raw muscle becomes practically negligible in meat as ordinarily eaten. Even in liver, which is normally well supplied with vitamins A and B, vitamin C is found in low concentration and is lost in cooking. (Rose, p. 305.)
>
> The vitamin C which they (kidney and liver) contain is mostly destroyed in cooking. (Rose, p. 429.)
>
> Muscle tissues, ordinary meats, are so poor in antiscorbutic vitamin that attempts to show its presence by experiments upon guinea pigs have given negative results. . . . Dutcher, Pierson and Biester (1919) were not able to observe any antiscorbutic effect from raw lean beef fed to guinea pigs. (Sherman and Smith.)
>
> . . . meat, if eaten sufficiently fresh, raw, or "rare" and in large quantities has an appreciable though small antiscorbutic value. (Sherman and Smith.)
>
> In view of the fact that even when eaten in very large amounts meat can be expected to prevent scurvy only if eaten raw or nearly so, we must conclude that cooked meat, as ordinarily eaten, probably furnishes but insignificant amounts of the antiscorbutic vitamin. (Sherman and Smith.)

Few readers would think either from these quotations or from the whole of the cited book of Dr. Rose that it would be possible to live in good health on a diet consisting of thoroughly cooked meat (medium-done to well-done) and from which diet are absent most or all of the organs described as "particularly rich in vitamin C." But it is known to students of "primitive" peoples, whether ancient or modern, that this is just what hunting man has been doing from time immemorial.

The records of travelers, field anthropologists and frontiersmen (*e.g.*, post managers of the Hudson's Bay Company throughout the north of Canada) are full of case histories and general information which show that exclusive meat-eaters never show a vitamin C deficiency and that many of them consume few or none of the organs said to be rich in vitamin C.

Nor do all groups of exclusively carnivorous people eat large or even considerable amounts of raw or underdone animal tissue, as Rose and Sherman-Smith say and imply they would have to do in order to avoid scurvy.

The diet experimenters and the diet historians are, then, in square contradiction. The experiments say of animal tissues that vitamin C is negligible to begin with, except in certain glandular organs, and that in any case this vitamin C is nearly or quite destroyed by ordinary cooking; so that to avoid scurvy on a meat diet you have to eat considerable quantities of these organs and have to eat them raw or underdone. To this contention the diet historians reply that meat-eaters, such as the northern Canadian Eskimos and the northern Athapascans, feed to dogs or throw away most of the "glandular organs rich in vitamin C"; and that the Athapascans, without ever developing scurvy symptoms, punctiliously cook their food to that extent which Rose and Sherman-Smith say or imply would either wholly or practically destroy their vitamin C efficiency.

With regard to the solution of this apparent dilemma between the animal experimenters and the observers of "primitive" human diets, we make four suggestions:

(1) The experimenters reach unsound conclusions with regard to human needs when they analogize for vitamin C from guinea pigs to humans.

(2) Those who measure the vitamin C content of animal tissues through the current methods have probably overestimated by from two to ten times the amount necessary to prevent scurvy symptoms in man—or perhaps they have underestimated the superiority of the human over the guinea pig mechanism for extracting and utilizing vitamin C.

(3) The experimenters have overestimated the destructive effect of ordinary cooking upon the vitamin C efficiency of animal tissues—in all probability the vitamin C is greatly weakened or destroyed only in the outermost layer of a piece of meat. Most carnivorous people boil or roast their meat in large pieces and cook to where the outside only is well done while the inside of either boiled or roast is about like the inside of our roasts. In such cooking the vitamin C efficiency may remain nearly or quite undiminished through 90 per cent. of the diameter of each chunk.

(4) Or possibly there is some component of animal tissues other than vitamin C which is able to prevent scurvy.

Perhaps the solution is in a combination of two or more of the suggestions, or in one that has not occurred to us. In any case, it is as necessary for the experimenters and the observers to get together on the "vitamin C in animal tissues" problem as it was for the astronomers and the geologists to get together on the chronology of the solar system.

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A QUANTITATIVE MEASUREMENT OF THE NATURAL RATE OF GROWTH OF CALCITE CRYSTALS IN GEODES

THERE has lately come under the observation of the writer some crystals formed in artificially manufactured stone under circumstances which give some information concerning the time during which the growth of these crystals has taken place, and, therefore, a quantitative measurement of the rate of this growth.

The Chemistry Building of Texas Technological College, in common with other buildings of the campus, is of the Spanish Renaissance type of architecture, with cloisters extending along the whole length of the building on the front. On each of the arches of these cloisters there are ornamental columns of cast stone.

In the manufacture of these columns some defects occurred, leaving small cavities near the surface. In some places the covering of these cavities has weathered off in part, exposing the interiors, which are seen to be lined with small crystals.

The cavities described above have a maximum size of about 15 mm and range in depth from 3 to 5 mm.

The crystals which line these cavities when examined under the microscope are seen to be prisms and scalenohedrons of calcite. They range in size from 1.0 mm to 2.5 mm in length and from 1.0 mm to 1.5 mm in thickness.

Since these crystals have evidently been formed since the construction of the building, they seem to constitute an interesting basis for a quantitative measurement of the rate of growth of such crystals. The building was completed early in the year 1929, so these crystals must have developed in the cavities within this ten-year period.

The writer is not aware of any quantitative data on the rate of natural growth of calcite crystals in geodes, but it seems that the development of these crystals within this time limit is growth at a more rapid rate than is generally believed. This seems especially true since the conditions under which these crystals formed are probably much more unfavorable for crystal growth than the conditions in rocks *in situ*.

The cast stone columns are so placed on the arches of the cloisters that there is little, if any, opportunity for ground water to enter the pores of the rock, and certainly not in the proportion to that of rocks *in situ*. The water which has acted as the agent of solution and deposition must in this case have been derived, largely if not altogether, from rainfall. In the climate in which this building is situated, however, there are normally long seasons of dry weather, and even the total rainfall for an entire year is not large.

Another condition which would be less favorable for the growth of crystals is that the proportion of calcium carbonate in the stone is relatively much smaller than in many rocks, such as limestones, in which calcite geodes occur.

Since these crystals have developed in a relatively short time, under conditions that are more or less unfavorable, they seem to offer an interesting illustration that processes, which may ordinarily be regarded as very slow, may sometimes proceed at a more rapid rate than usually supposed, the general opinion regarding the rate of the process being influenced, no doubt, by the natural tendency to regard all geologic processes as consuming great amounts of time.

LEROY T. PATTON

TEXAS TECHNOLOGICAL COLLEGE

PANTOTHENIC ACID—A VITAMIN

THE discovery of Jukes[1] and of Woolley, Waisman and Elvehjem[2] indicating plainly that the "chick anti-dermatitis factor" is identical to pantothenic acid, which has been investigated in the writer's laboratory, comes as a welcome confirmation of a suspicion which has long been entertained—namely, that pantothenic acid is a vitamin of importance in animal nutrition. It seems likely that this particular compound, which appears to be universally present in living tissues, will be found to be required by higher animals in general.

A partial synthesis of pantothenic acid somewhat similar to that reported by Woolley, Waisman and Elvehjem was carried out in the author's laboratory in June, 1938, but publication was deferred pending further investigation. This partial synthesis, based upon our finding that pantothenic acid was a derivative of β alanine,[3] was mentioned orally to a few individuals, but we have no reason to doubt but that it was accomplished by Woolley, Waisman and Elvehjem independent of any knowledge of the procedure which we employed. The Wisconsin workers and Dr. Jukes, of the University of California, are to be congratulated on the clear-cut character of their results.

ROGER J. WILLIAMS

OREGON STATE COLLEGE

THE EFFECT OF X-RAY ON THE COCCIDIA OF THE RABBIT

INTRACELLULAR stages of rabbit *Eimeria* have been found to be susceptible to the x-ray. Skin dosage of as little as 150r. at 70kvp. causes a sharp decline in oocyst production, while skin dosage of 450r. at 70kvp. completely stops oocyst production for from five to seven days, after which a relapse occurs in which oocyst production varies considerably from day to day with a gradual decline, which in one instance reached zero on the sixteenth day after the relapse. At no time during the relapse has the production of oocysts reached the same volume as before raying.

From these observations it is evident that the gametocytes are more susceptible than the asexual stages, but the exact developmental stages which are most susceptible have not yet been determined because of lack of complete information on the life cycle of the coccidia studied.

It is indicated that laboratory animals as well as valuable stock and pets might be freed from coccidia by the use of x-ray.

This work is being extended to the coccidia of poultry.

RALPH F. HONESS

THE UNIVERSITY OF WYOMING

SCIENTIFIC BOOKS

THE GEOLOGICAL SCIENCES

The Birth and Development of the Geological Sciences. By FRANK DAWSON ADAMS. $5.00. 506 pages. Illustrated. Williams and Wilkins.

THIS copiously illustrated volume is a very welcome addition to the rather scanty literature dealing with the history of geology and the related sciences. Whereas the widely used treatises of Zittel, Geikie and Merrill deal mainly with the development of geological science during the last two centuries, it gives much larger space to the consideration of the more ancient writers and the first attempts, often naive and unscientific, to explain the phenomena of the earth.

During Dr. Adams's long life of devotion to education and science at McGill University, he has become a conspicuous leader in geological research. His intimate friends have long known of his passion for rare and ancient books, and many have envied him his remarkable collection of more than a thousand such books dealing with geological topics. And now with characteristic generosity, he gives to the world the benefit of his activities as a bibliophile.

After a survey of geological science, or the lack thereof, in classical times and a general investigation of the conception of the universe in the Middle Ages, a half dozen of the subdivisions of the broad science of geology are considered in sequence. There is a chapter on the ancient controversies concerning the "generation of stones" and two chapters devoted to "Medieval Mineralogy" and "The Birth of Modern Mineralogy and its Development from Agricola to Werner and Berzelius."

Next comes an account of the birth of historical geology in which due attention is paid to the rise and fall of the "Neptunian Theory." This is followed by chapters dealing with the birth of paleontology, the early investigations of metalliferous ore deposits, the origin of mountains, the attempts to explain earthquakes and the origin of springs and rivers. Where it seemed advisable to do so, Dr. Adams has briefly sketched the more recent developments of geological principles and theories. In the concluding chapter, there is an appraisal of the reasons why the earlier seekers after knowledge were so often turned aside into the by-paths of misunderstanding and error, and a brief glance at the promising new fields of investigation which are now becoming available for the geologist of the twentieth century.

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[1] *Jour. Amer. Chem. Soc.*, 61: 975, 1939.

[2] *Jour. Amer. Chem. Soc.*, 61: 977, 1939.

[3] This relationship was reported both at the International Physiological Congress in August, 1938, and at the American Chemical Society meeting in Milwaukee, September, 1938. A paper on the subject is now in press.

There is unfortunately an inexcusably large number of typographical errors in the text. The reader, moreover, can not fail to note the great disparity between the author's style in various portions of his work. Some of the paragraphs would rate high in any literary critic's scale of merit, whereas others seem to be merely a succession of hasty notes casually assembled for the printer. Despite these shortcomings, the book will prove of great interest not only to geologists, mineralogists and paleontologists, but also to those who seek an intimate acquaintance with the thought patterns of ancient and medieval times.

KIRTLEY F. MATHER

HARVARD UNIVERSITY

CHEMISTRY OF THE CARBON COMPOUNDS

Richter-Anschütz. The Chemistry of the Carbon Compounds; Vol. II, The Alicyclic Compounds and Natural Products. Translated from the 12th German edition and revised by T. W. J. TAYLOR and A. F. MILLIDGE. Pp. xii + 656. Nordemann. $15.00.

THE second volume of this admirable handbook will be welcomed by all organic chemists, to whom the earlier editions have been well and favorably known for so many years. It will be especially helpful to those Americans not familiar with the German language, since 17 years have elapsed since Blakiston published D'Albe's translation of the eleventh German edition.

This volume is not merely a translation of the German text (which appeared in 1935), but represents also an expansion and rewriting of various sections, so far as possible with the collaboration of the original contributors, in order to harmonize and bring the material up to date. Those familiar with the fields covered and the speed with which they have been advancing in the last few years, will appreciate the magnitude of this task. A valuable new feature is the replacing of the *Zentralblatt* references by references to the original papers and the inclusion of the names of the authors.

Richter-Anschütz is a veritable mine of information, not alone by virtue of its text, but also because of the wealth of its references to the original literature. Standing as it does between the monumental encyclopedias of the Beilstein type and the numerous college text-books, it is unrivaled in its field and an invaluable aid to the teacher and investigator in the vast domain of organic chemistry. Treatises and reviews, of course, are available which cover separate chapters in much greater detail, but no single work in the English language, of similar size, presents with such thoroughness and compactness our existing knowledge of the subject. Its only handicap is the high cost for the complete work of four volumes.

MARSTON TAYLOR BOGERT

Season of Birth: Its Relation to Human Abilities. By ELLSWORTH HUNTINGTON. New York: John Wiley, vii + 473 pp. 5½ × 8. 1938.

AN editorial review in the *Journal* of the American Medical Association states: "This remarkable book is one of fundamental importance in human biology and should be read by every physician and worker in fields concerned with racial reproduction"—"with full supporting facts"; "one feels inclined to accept his conclusions as proved."

A review by J. S. Wile (*Americal Journal of Orthopsychiatry*): "As an exceedingly useful document whose theory and supporting evidence are most challenging, it should command wide attention."

C. E. P. Brooks, in the *Meteorological Magazine* (British): "Huntington has now proved that climate is of even greater importance with respect to birth than later in life."

From reviews in other journals, the following quotations may be selected: "It contains a vast amount of evidence from all parts of the world." "Millions of factual data are presented in readily comparable graphs." "Valuable also as an example of readable presentation of large bodies of statistical data." "Will increase Dr. Huntington's already great reputation as a persistent seeker after the significances of the environment and as one who earnestly strives to make his discoveries widely useful by using great care in presenting them effectively and interestingly."

In brief: Seasonal influences apparently affect appreciably the survival rate in all stages of life, the sex ratio and the proportion of people possessed of superior energy and ability. The best time for conception and birth varies with region and weather as well as with climate and numerous other factors. In general, it appears that the month when temperature conditions most closely approach the optima for human physical health is best for conception, provided that when birth occurs average temperatures are close to optimum for mental activity. These temperatures have been found by several investigators to be about 63° and 50°, respectively. Mental activity appears to have been especially important in giving the infant a good start in life during the early, doubtless difficult stages of the development of *Homo sapiens*, when these optima presumably were established. People conceived and born under favorable temperature conditions live on the average more than a year longer than those less fortunately timed, and throughout their life have better health and more energy.

STEPHEN S. VISHER

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SPECIAL ARTICLES

OCEAN-BOTTOM CURRENTS OFF THE CALIFORNIA COAST*

THE existence of appreciable currents at great depths in the open sea has been demonstrated by Norwegian and German oceanographers[1] through measurements made from anchored ships. These observations, however, were usually carried out at distances of several hundred meters above the ocean bottom. Recently Stetson[2] has measured velocities near the sea floor in the submarine canyons off the New England coast, using a device which allowed him to suspend a current meter within 28 centimeters of the bottom. He obtained velocities up to 11 centimeters a second and interpreted these movements as tidal manifestations.

During the past year the writers have made many series of bottom current measurements, including approximately 200 individual observations. In much of this work a tripod designed by C. I. Johnson and Revelle[3] has been used to suspend an Ekman current meter at distances between 125 and 20 centimeters above the ocean bed. The observations have been made in six submarine canyons at depths ranging from 42 to 840 meters; on an open continental shelf at 73 meters; on a straight steeply sloping submarine scarp at a depth of 375 meters; on a 760-meter saddle between two basins; and in a comparatively shallow-rimmed basin at a depth of about 890 meters. Observations over time intervals of five to fifteen minutes were made as rapidly as possible for periods between 8 and 35 hours in the submarine canyons and for 20 hours on the continental shelf.

The results of this work were largely unexpected. While the full significance of the observations can be determined only by further investigation, some preliminary conclusions appear to be warranted from the available data. Thus it may be seen from Table 1 that the maximum velocities of these bottom currents are of the same order of magnitude as that of most surface currents in the open sea. The velocities are, however, not comparable with those found in rivers on land nor in narrow tidal passages, since they do not exceed 37 centimeters per second (0.7 nautical miles per hour). The maximum current velocities observed in deep water were as high as those found in shallow water. The observations do not show any significant relationship between maximum current velocities and the different types of bottom topography, nor is there evidence to indicate that the currents are stronger where the bottom is sandy or rocky. It is possible, however, that such relationships might be revealed if a sufficiently long series of observations were available from several localities.

Where observations were continued for a considerable period, it became evident that both the speeds and directions of the currents were constantly shifting (Fig. 1). A considerable number of observations

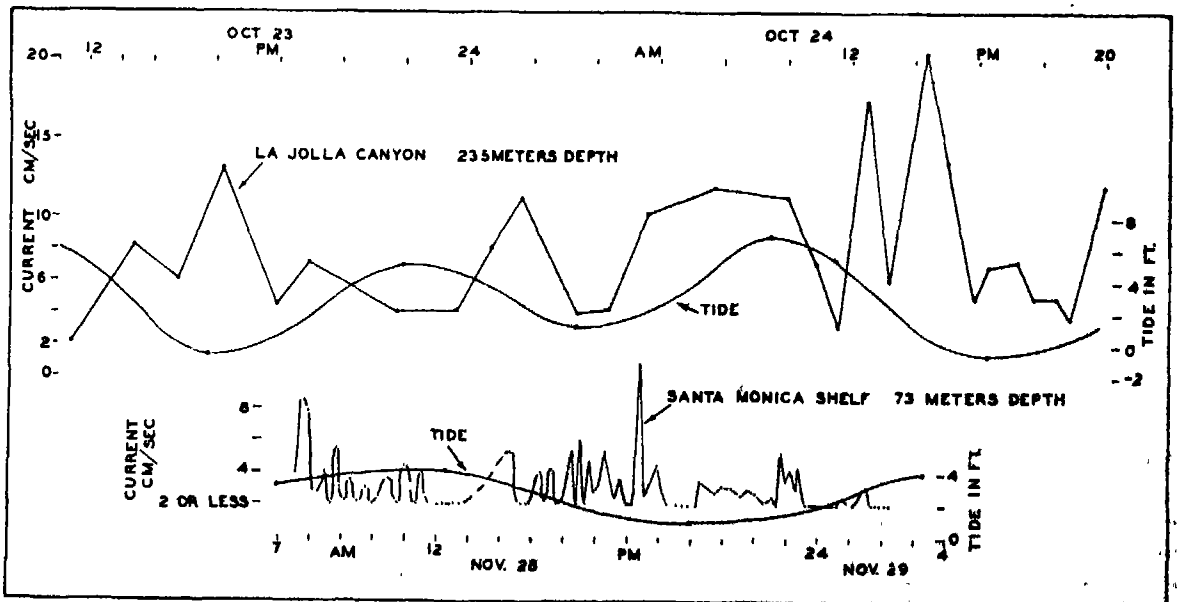

FIG. 1. Observed current speeds in La Jolla submarine canyon and on the continental shelf off Santa Monica, measured at a height of 125 centimeters above the bottom.

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* Contributions from the Scripps Institution of Oceanography, New Series No. 53.

[1] B. Helland-Hansen, "Michael Sars North Atlantic Deep Sea Exped., Scientific Results," Vol. 1, pt. 2, pp. 106–113, 1930. A. Defant, "Wiss. Ergeb. d. Deutschen Atlantischen Exped. auf dem Forschungschiff *Meteor*," 1925–1927. Bd. 7, 1932.

[2] H. C. Stetson, *Trans. Am. Geoph. Union for 1937*, pp. 216–219.

[3] R. H. Fleming and Roger Revelle, "Current velocity profiles near the sea bottom." To be submitted to the *Journal of Marine Research.*

TABLE I

MAXIMUM OBSERVED BOTTOM VELOCITIES AT VARIOUS LOCALITIES

Depth meters	Maximum velocity cm/sec.	Submarine topographic feature	Nature of bottom	Number of observations
42	7.3	La Jolla Canyon	Silty sand (thin cover)	14
58	10.6	Newport Canyon	Black mud	15
73	10.7	Santa Monica Shelf	Silty sand and rock	80
91	26.9	Monterey Canyon	Sandy silt (thin cover)	16
182	14.7	Scripps Canyon		6
235	20.4	La Jolla Canyon	Silty sand	31
375	36.7	Scarp off San Pedro hill	Sandy silt	6
560	23.0	La Jolla Canyon	Silty sand	6
759	8.8	Saddle near San Clemente Island	Glauconitic and calcareous sand	2
780	18.8	San Pedro Canyon		1
796	20.8	Coronado Canyon	Mud	4
840	8.0	San Pedro Canyon	Rock and sand	3
886	17.7	San Pedro Basin	Silty mud over sand	3

showed the absence of a velocity strong enough to make a record (less than 2 or 3 cms per second). Such periods were occasionally followed by some of the highest measured velocities. In the submarine canyons the observed directions of movement showed a tendency to follow the axes of the canyons, but shifts in direction from up to down canyon occurred at irregular intervals. The bottom currents thus appear to be non-tidal in character, although they exhibit some tidal components. Even on the continental shelf where tidal components might be expected to predominate, non-periodic changes in velocity were encountered.

The observed irregular movements of the bottom water probably can be best interpreted as indicating the presence of large moving eddies with vertical axes.[4] The presence of silts and muds on the bottom in certain areas of highest observed currents indicates that these eddy currents are not competent to prevent all deposition. Nevertheless, such currents must play an important part in the transportation of fine sediment along the sea floor. Since evenly distributed eddies can not alone produce any net transport, however, other factors such as the gravitational component down slope and residual currents must cooperate to prevent deposition on the many areas of hard bottom off the California coast. Possibly, also, the currents are not as competent to move debris as might be expected from observations on the transporting power of rivers, since it is probable that velocities decrease more rapidly near the sea bottom[5] than near the bottoms of rivers.[6]

These bottom currents may be looked on as part of a mechanism for carrying sedimentary material, brought into the ocean by floods or by wave erosion, out into considerable depths of water. This transporting ability, however, should not be thought of as equivalent to cutting power sufficient to erode great submarine canyons out of the rock of the ocean bottom.

Acknowledgements: The work described in this note was made possible through a grant from the Geological Society of America to Shepard and through the active cooperation of the Scripps Institution and the assistance of the Kerckhoff Marine Laboratory.

F. P. SHEPARD
R. REVELLE
R. S. DIETZ

SCRIPPS INSTITUTION AND THE
UNIVERSITY OF ILLINOIS

INHIBITION OF GASTRIC SECRETION BY EXTRACTS OF NORMAL MALE URINE[1]

IT is a well-established fact that gastric secretion and motility are inhibited by the ingestion of fat. That the inhibition is mediated humorally was proved in 1926 by Farrell and Ivy,[2] who found that the oral administration of fat inhibits motor activity in the transplanted and denervated gastric pouch. Feng, Hou and Lim[3] subsequently demonstrated that fat also inhibits secretory activity of the transplanted gastric pouch. Quigley, Zettleman and Ivy[4] showed that sugars likewise inhibit gastric motility by a humoral mechanism. It has been demonstrated that the humoral agent is not fat or one of its products of digestion, nor a constituent of thoracic duct lymph. Bile and the duodenal hormones, secretin and cholecystokinin, have also been eliminated from consideration.[3, 4] Evidence that the humoral agent is a specific duodenal chalone was proved by Lim and his coworkers,[5] who, after finding that a preparation of duodenal mucosa provided by Ivy inhibited gastric secretion, successfully prepared extracts of the duodenal mucosa which inhibited gastric secretion and motility. The active principle was given the name enterogastrone. Gray, Bradley and Ivy[6] later prepared more potent extracts of enterogastrone and defined a tentative unit based on the degree of inhibition of gastric secretion in dogs.

Although we have previously believed that both motor and secretory inhibition were produced by one substance, we have recently discovered that wide variations in the ratio of secretory to motor inhibition may occur in preparations subjected to different methods of concentration. This suggests that enterogastrone may consist of two principles, one which inhibits secretion and one which inhibits motility. A difficulty in the biological assay has arisen from the fact that animals occasionally become refractory to enterogastrone preparations because of protein impurities.[7] For this reason we have not tried our preparation in the treatment of "peptic" ulcer.

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[4] C.-G. Rossby, *Jour. Marine Research*, 1: 3, 239–262, 1938.

[5] Fleming and Revelle, *ibid.*

[6] W. W. Rubey, *U.S.G.S. Professional Paper* 189E, p. 132, 1938.

[1] Aided in part by a grant from the Committee on Endocrinology of the National Research Council.

[2] J. I. Farrell and A. C. Ivy, *Am. Jour. Physiol.*, 76, 227, 1926.

[3] T. Feng, H. Hou and R. K. S. Lim, *Chin. Jour. Physiol.*, 3: 371, 1929.

[4] J. P. Quigley, H. J. Zettleman and A. C. Ivy, *Am. Jour. Physiol.*, 108: 643, 1934.

[5] T. Kosaka and R. K. S. Lim, *Chin. Jour. Physiol.*, 4: 213, 1930; *ibid.*, 7: 5, 1933; R. K. S. Lim, S. M. Ling and A. C. Liu, *ibid.*, 8: 219, 1934.

[6] J. S. Gray, W. B. Bradley and A. C. Ivy, *Am. Jour. Physiol.*, 118: 463, 1937.

Our attention has been recently directed to the urine as a possible source of enterogastrone uncontaminated by the protein impurities which are present in the mucosal extracts Sandweiss, Saltstein and Farbman[8] recently reported that extracts of pregnancy urine (Antuitrin-S) containing the gonadotropic hormone, prolan, are potent in preventing the development of jejunal ulcers in dogs subjected to the Mann-Williamson operation. Culmer, Atkinson and Ivy[9] have administered extracts of pregnancy urine daily to Pavlov pouch dogs and observed a significant reduction in gastric secretion. Since the inhibition was evident on the first day, within one-half hour after the first injection of the extracts, it was concluded that the latter had a direct action on the gastric glands. Necheles has stated that he was able to extract from human urine a substance which inhibits gastric secretion.[10] At the San Francisco meeting of the American Medical Association, Sandweiss and associates reported that extracts of normal female urine are also potent in preventing experimental ulcers in dogs. This finding definitely excluded prolan as the active constituent, since this hormone is believed to originate in the placenta. Recently Sandweiss placed at our disposal a sample of this extract of normal female urine, which we found to be potent in inhibiting gastric secretion in dogs. Since the first possibility to be considered in explaining this observation is that enterogastrone is excreted in the urine, we have attempted to extract the chalone from this source.

We have found that extracts of normal male urine, prepared by benzoic acid adsorption or tannic acid precipitation,[6] are very potent in inhibiting gastric secretion. Three milligrams of solid material, representing approximately 150 cc of urine, contain one enterogastrone unit of activity. This material is approximately 16 times as potent as the usual material prepared from the duodenal mucosa of hogs. Two dogs which have become refractory to mucosal preparations have responded to the urine extracts. No inhibition of gastric motility has been obtained with as much as three milligrams of the urine preparations, so that either the substance acting on gastric motility is not eliminated in the urine or else the method employed does not recover it. An assay carried out on five immature rats has revealed that three mgs of the urine preparations exhibit no trace of gonadotropic activity. The active principle is not affected by boiling for five minutes.

Although both the chemical and biological behavior of the substance in urine resembles that of duodenal preparations of enterogastrone, we can not as yet state that the active constituent of urine is actually enterogastrone. Attempts to identify the principle are in progress.

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[7] J. S. Gray and E. Wieczorowski, *Proc. Soc. Exp. Biol. and Med.*, in press.

[8] D. J. Sandweiss, N. C. Saltstein and A. Farbman, *Am. Jour. Dig. Dis. Nut.*, 5: 24, 1938.

[9] C. Culmer, A. J. Atkinson and A. C. Ivy, in press.

[10] H. Necheles, *Proc. Am. Gastroenterol. Soc.*, May, 1938.

NICOTINIC ACID IN SWINE NUTRITION

IN November, 1938, a herd of pigs in northwestern Pennsylvania was reported to the agricultural extension specialists of the Pennsylvania State College as being sick and unthrifty. These pigs were farrowed in September and weighed from twenty to forty-five pounds. Out of a total of seventy-six pigs, forty had died during October and November. The surviving pigs had stopped growing, were without appetite and were affected with diarrhoea and a dermatitis on the body and ears which had the appearance of a heavy scurf. This condition developed while the pigs were being fed a ration of corn, oats, wheat middlings, tankage (34 per cent. protein) and a limited amount of skimmed milk. They had access to good grass pasture which had never previously been used for swine.

At the time the case was reported these pigs were accustomed to huddle in their pens rather than to take advantage of the available pasture. When food was placed before them they would come to the trough, eat a small amount and refuse the remainder of the feed.

The condition of these animals baffled the local and district veterinarians and the case was brought to the attention of the college swine specialist. It was then noted that the symptoms of the disorder were similar to those reported by Chick and co-workers,[1] with pigs suffering from nicotinic acid deficiency on a diet consisting largely of maize. As a result of this observation seven pigs, having been selected as being in the poorest condition of any in the herd, were given 50 mg daily of nicotinic acid mixed in a minimum amount of feed to insure its complete consumption. Within twelve days a marked improvement was noted in these seven pigs. A return of appetite was apparent and increased physical activity was displayed, the pigs searching for food and having every indication of return to normal health. The dermatitis disappeared from the ears where new hair began to grow and the scurf on the back was lifted by the growth of the new hair.

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[1] *Biochem. Jour.*, 32: 10–12, 1938.

Nicotinic acid was then given to the entire herd in 50 mg daily amounts mixed in the feed, and complete recovery was made by all the pigs as noted with the previous seven. The dramatic response to nicotinic acid treatment is similar to that described by Chick. The feeding of nicotinic acid was continued for two weeks. As pasture was not available ground alfalfa and cod liver oil were then included in the ration. Within six weeks the entire herd had completely recovered, growth having been resumed and the entire lot of pigs appearing to be normal.

This is believed to be the first time that a nutritional disorder simulating swine pellagra has been reported as occurring under conditions of agricultural practice. The effectiveness of the administration of nicotinic acid in alleviating the condition adds further proof as to its identity. It is not believed that this condition occurs in practice to any great extent, especially as affecting entire herds as in this case. However, individual pigs are sometimes seen whose condition resembles that described above.

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R. C. MILLER
T. B. KEITH
PENNSYLVANIA STATE COLLEGE

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A PRECISION DEVICE FOR FARADIC STIMULATION[1]

MUCH of the confusion surrounding evidence on cerebral localization arrived at by stimulation may be due to lack of precise methods. As an essential first step in clarifying this situation it is felt that certain descriptive criteria should be agreed upon. Suitable criteria for faradic stimulation are: (1) intensity; (2) frequency; (3) wave form.

The expression "voltage" has little descriptive value because of the varying and indeterminable fraction of the total voltage "drop" that takes place "across" the neurological unit under stimulation. Crude tests of current strength likewise are inadequate. "The smallest current that will produce a contraction of the temporal muscle" may cause a more vigorous contraction or none shortly afterward, or in a different area.

With a stimulating device of the voltage-regulating type one can not precisely control or reproduce the current reaching a neurological unit because of the varying resistance of the subject pathway and its segments. A rational solution of this difficulty is provided by the current-regulating form of device in which relatively high voltages are applied through resistors of such large order that alterations in the subject pathway leave the preselected current level practically unchanged.

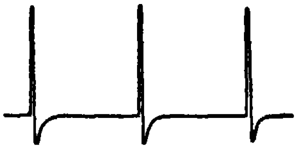

FIG. 1. Tracing of oscillograph image of wave form delivered by stimulator. Wave form constant over the range of intensities.

In 1937 Newell and the writer described a simple device of this type for faradic stimulation in which intensities were read directly on a meter. The sine wave form was used. Intensities could be selected in advance, and, of course, exactly duplicated in any succeeding experiment.[2] However, it is now felt that the sine wave probably is not as satisfactory as one in which there is a sharp rise and fall of electromotive force.

Of wave forms that satisfy this criterion and that may readily be duplicated in other laboratories, that of the condenser discharge recommends itself. Accordingly, with the engineering assistance of Dr. G. V. Nolde[3] we have devised and tested a stimulator for laboratory and clinical faradization patterned essentially after that of Schmitt and Schmitt[4] but modified by the addition of an amplifier stage and large resistance banks to make possible delivery of graded, predetermined intensities of current. The wave form is shown in Fig. 1. A frequency of 50 cycles a second is used, though an adjustment makes a variety of frequencies available.

The condenser C_1 (Fig. 2) is charged through resistor R_1 until the firing potential of thyratron 885 is reached, when discharge through T_1 overcomes the

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[1] From the Department of Surgery, Stanford University School of Medicine, and the Stanford Surgical Service of the San Francisco Hospital. Financed by a grant from The Committee on Scientific Research of the American Medical Association.

[2] Frederick A. Fender and R. R. Newell, *Archives of Neurology and Psychiatry*, 38: 1289, December, 1937.

[3] The stimulator here described is very competently manufactured by the Butte Electric and Manufacturing Company, 24 Sterling Street, San Francisco.

[4] Otto H. A. Schmitt and Francis O. Schmitt, SCIENCE, n.s., 76: 328, October 7, 1932.

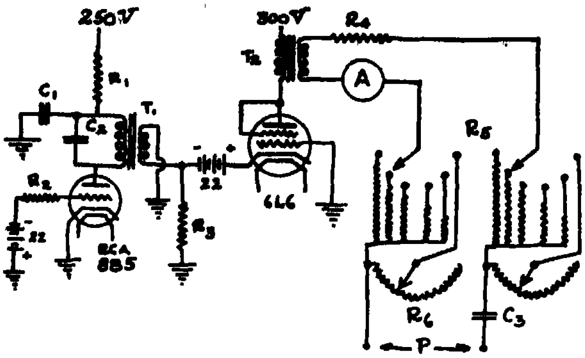

FIG. 2. Circuit. The plate supplies of the two tubes are not shown. These come from a single power pack utilizing an Inca C–65 transformer, a 5Y3 tube, two 12 henry chokes, two 4 microfarad condensers, and a 50,000 ohm resistor from which the 250-volt line is taken. The transformer heats the rectifier filament and supplies the heaters of 885 and 6L6 using a separate secondary and resistances of 3.4 and 1.38 ohms, respectively. R_1 – 50,000 ohms; R_2 – 20,000 ohms; R_3 – 5,000 ohms; R_4 – 100,000 ohms; R_5 – ganged resistors of 10 meg, 5 meg, 2 meg, 1 meg and 0.5 meg each; R_6 – two ganged zero to 500,000 ohm resistors. C_1 – 0.5 mf; C_2 – 0.02 mf; C_3 – 0.5 mf; A – zero to 200 copper-oxide rectifier type microammeter. T_1 – Thordarson 67 D 50; T_2 – Thordarson 14 A 29.

fixed negative potential impressed upon the grid of amplifier 6L6 to allow current to flow in this tube, T_2, and the output circuit. Average current is read directly on microammeter, A. Peak values are arrived at by multiplication by a constant for the unit. The stimulator has been used on patients on the service of Dr. Leo Eloesser at the San Francisco Hospital and on animals for direct and through-the-skin stimulation of peripheral nerves and for stimulation of the cortex cerebri.

It is felt that if faradic current used in a given project is accurately characterized as regards intensity, frequency and wave form there may be more uniformity in results of electrical stimulation of nervous tissue. We are left with two objectionable variables: the physical status, degree of narcosis, etc., of the subject; the complex phenomenon "spread." Concerning the second we are attempting to gather some information in the surgical laboratory at Stanford.

FREDERICK A. FENDER

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AN APPARATUS FOR REMOVAL OF DELETERIOUS BACTERIA FROM CERTAIN PROTOZOAN CULTURES

PROTOZOA cultures periodically become contaminated with deleterious bacteria. When this occurs the metabolic activity of the culture is lowered and often the clone is lost.

The following is a description of an apparatus based on the migration which protozoans show in an electric field towards the cathode. This enables the operator to remove a high percentage of harmful bacteria, and allows the culture to resume its normal growth.

Two platinum wires are fused into the side of a pyrex petre dish. A U-shaped piece of glass tubing is closed at both ends and the longitudinal surface ground, until an open channel results. This channel is filled with sterile hay infusion. The two platinum wires are placed at the extreme end of the glass channel, while the free ends are connected to a suitable electric current.

The protozoa to be partially sterilized are placed near the anode and the current turned on. Under the influence of the electric field the protozoa swim towards the cathode, leaving the bacteria behind them. They are then removed from the fluid by means of a capillary pipette as they near the cathode.

Paramecia treated as described above were no longer seriously contaminated by harmful bacteria. Although far from completely sterilized, they were able to resume normal growth.

WALTER STEWART

THE JOHNS HOPKINS MEDICAL SCHOOL

BOOKS RECEIVED

ASHBY, HELEN, ERIC ASHBY, HARALD RICHTER and JOHANNES BÄRNER. *German-English Botanical Terminology.* Pp. xi + 195. Nordemann. $3.00.

COFFMAN, RAMON P. (Uncle Ray) *The Child's Story of Science.* Pp. viii + 246. Illustrated. Putnam. $2.50.

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COON, CARLETON S. *The Races of Europe.* Pp. xv + 739. Illustrated. Macmillan. $7.00.

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THE DEDICATION OF THE McDONALD OBSERVATORY

Edited by Dr. OTTO STRUVE

DIRECTOR OF THE YERKES AND MCDONALD OBSERVATORIES

THE dedication of the W. J. McDonald Observatory of the University of Texas, on Mount Locke, near Fort Davis, Texas, took place in the afternoon of Friday, May 5. More than 400 invited guests from all parts of the United States, from Canada, Mexico and some European countries were present on the observing floor of the 62-foot dome. The speakers were located on the observing bridge. Dr. Edward Randall, vice-chairman of the Board of Regents of the University of Texas, introduced the speakers.

The session was opened by Mr. C. J. Stilwell, president of the Warner and Swasey Company, who described the activities of his firm in the production of large telescopes and who formally turned over the keys of the dome to Dr. Otto Struve, director of the McDonald and Yerkes Observatories.

In accepting the observatory from the Warner and Swasey Company Dr. Struve spoke as follows:

The purpose of this observatory, in the words of the man whose name it bears, is "the study and promotion of the study of astronomical science." To promote the study of astronomical science means to discover the fundamental laws of nature which govern the structure of the material universe and the changes within it. It means that astronomers must not be passive observers of strange and unexplained phenomena in the cosmos but must be active and intelligent explorers of the vast unknown.

Mr. Stilwell, when I recommended in 1933 to the Board of Regents of the University of Texas that the contract for this observatory be awarded to the Warner and Swasey Company, I knew that your distinguished director of engineering, the late Mr. E. P. Burrell, would be able to meet the exacting specifications which our committee of astronomers had prepared. The telescope was not intended to be just one more expensive gadget to be discarded, ultimately, in the graveyard of scientific instruments. It was to produce answers to a number of specific questions. If it succeeds in this task it will have served its purpose. If it does not succeed, we shall be obliged to regard it as an expensive failure.

There is a story connected with the first attempt to anneal the great mirror disk, after it had been successfully cast at the Corning Glass Works on the last day of 1933. The glass was slightly checked in several places when the annealing oven was removed several months later, and the Corning experts, Dr. Hostetter and Dr. McCauley, immediately offered to melt the glass and to anneal it a second time. During this process of melting, the liquid glass pressed against the firebricks, of which the mold was constructed, and pushed them slightly apart—with the result that we finally got a disk of 82½ inches instead of the contracted disk of 80 inches! I do not guarantee the absolute correctness of this story, but we did get, by some stretching, an 82½-inch disk.

Unfortunately, this is all the stretching our mirror, or for that matter, the truth, will stand. The 82-inch is not a particularly large mirror, and some of our good friends are wasting their time in trying to prove that it will be just as powerful or just as efficient or, anyway, just as good as the Mount Wilson 100-inch. It will be nothing of the sort—as simple geometrical considerations will convince you. I wish we could do some more "stretching," but not even an expert in relativity could stretch the 82-inch mirror to measure 100 inches or to make the half-million dollars available for this project pay for a two-million dollar telescope.

If we can not excel in size we must excel in efficiency. Aperture is important; for some problems it is all-important. Such problems are not within the scope of our observatory. We shall not attempt to extend the geometrical boundaries of the universe of galaxies; this task is taken care of by Dr. Hubble at Mount Wilson. Nor shall we attempt to photograph stars within our own galaxy which are fainter than any hitherto recorded. Dr. Baade is engaged in this type of work with the 100-inch.

What we propose to do is to study intensively the relatively bright stars of our galaxy—as individuals and not only as statistical material. We want to know why it is that all matter in the world is segregated essentially in two forms—stars and nebulae. Why are there no stars which exceed in mass a few hundred times the mass of the sun? Why is it that nearly all stars and nebulae consist of the same chemical elements in roughly the same relative proportions as we find them in the sun? Where and how do the stars generate their stupendous energies of light and heat, and what is the ultimate fate of their radiation?

To answer these and many other similar questions we have made this telescope as efficient and as powerful as we know how for studying the spectra and the brightnesses of the stars and nebulae. We decided to make the telescope relatively short—only 27 feet in focus—so that the images of the stars would be small, even when the air outside is not quiescent. We even built a special spectrograph for the prime focus which effectively converts the telescope from an f/4 instrument to an f/2 instrument. We did this at a sacrifice in limiting faintness of the stars we can observe because we wanted to photograph rapidly hundreds of stars on one plate, instead of spending hours on every single object. There are a billion stars or more, which have never even been looked at and which this telescope will be capable of analyzing and classifying.

We wanted to get a mirror which would be perfectly free of all distortion when used visually or photographically. Corning supplied us with a Pyrex disk which changes little with temperature, and Mr. C. A. R. Lundin has put on it a figure so close to the true mathematical ideal that our experts assure us we have the finest astronomical mirror ever made.

The spectrographic requirements have been constantly in the foreground during the design of the telescope. That we have succeeded in our aim is amply demonstrated by the work of my colleague, Professor Kuiper, during the past six weeks. He has secured some 600 spectrograms of stars never before examined by any astronomer, and has added several brilliant discoveries to the list of his former achievements.

We are indebted to many friends and scientific colleagues for assistance in this project. Perhaps one of the most important features of the 82-inch is the Coudé arrangement for photographing stellar spectra with large prisms or gratings. I need not tell you that this idea was first successfully developed by Dr. Adams at Mount Wilson. We owe another important idea to Dr. Curtis, of Michigan. It was at his enthusiastic insistence that the prime focus and not the Newtonian focus should be used that we scrapped some of our plans—already partly executed—and built a large camera for the prime focus. The telescope drive originated at the McMath Observatory, and to Mr. Robert R. McMath and his collaborators we are deeply indebted for the great help which they gave us when we were designing our drive. My colleagues agree with me that this drive is practically perfect.

It would take too long to even briefly mention all those who have contributed to the success of the McDonald Observatory project. Many of them are here this afternoon.

One hundred years ago—in 1839—two of the world's greatest observatories were opened for research: the Harvard Observatory at Cambridge, Mass., and the Pulkovo Observatory near Leningrad (then Saint

Petersburg), Russia. We are fortunate in having with us here the distinguished director of the Harvard Observatory—Dr. Harlow Shapley. The director of the Pulkovo Observatory is not here—he is a recent victim of one of the most cruel dictatorships of all times. The disturbed international and political conditions of the world to-day are not conducive to quiet research. But the two observatories I have just mentioned have weathered many storms. In accepting this magnificent telescope I venture to hope that the McDonald Observatory is destined to weather the storms of the present and of the future and to become one of the great centers of research where the cultural treasures of the world are preserved and enriched.

A message by President Robert M. Hutchins, of the University of Chicago, who was prevented by illness from attending the dedication, was read by Dean Henry G. Gale, of the Division of the Physical Sciences of the University of Chicago:

This is a great occasion for science and for education. The scientific implications are clear enough. The educational implications are not so obvious, but they are just as important. Two universities are about to demonstrate the value of cooperation on a large scale. We have usually denied the possibility of cooperation. The experience of Texas and Chicago since this observatory was started shows that it is possible and even pleasant. Ever since President Benedict and I first talked about astronomy, the University of Chicago has enjoyed the most cordial relations with the University of Texas. In view of the distance that has separated us and the difficulties inherent in the early days of so vast a project, we can safely say that if we have got along up to now, we shall get along in the future. It is only fair to add that our task has been made easy by the confidence both institutions have had in the distinguished director of the observatory, Professor Struve. Without his unusual combination of energy, tact and scientific knowledge this gathering could not have been held to-day and might never have been held at all. On behalf of the University of Chicago, its faculty, students and trustees, I send the heartiest greetings to the University of Texas and the assembled guests of the observatory. This day will go down in history as one of the brightest in the annals of science and of the universities in America.

Major J. R. Parten, chairman of the Board of Regents of the University of Texas, then spoke for the university:

This is a happy day for Texas. On this day a dream which Texas has long been sharing with its friend and neighbor, Illinois, comes into reality. Texas in general, and the university in particular, can at last call the plant of a modern, powerful observatory their own.

William Johnson McDonald and Harry Yandell Benedict knew and loved the stars. . . . It is because of these two men that the observatory came into being, and that we have reason to be gathered here to-day. In accepting this immensely valuable laboratory for the university we feel that we stand in the light of a day the brightness of which will not soon dim. It is a day made bright by the presence of top-ranking scientists and leading educators, and a day made brighter still by the cherished memory of the two far-seeing Texans who made its sun rise. William Johnson McDonald provided the observatory in quantity of physical plant. Harry Yandell Benedict provided, by his planning and collaboration, the observatory in quality of structure and staff. . . . Our interim president, Mr. John William Calhoun, in 1924, two years before the McDonald bequest became known, put into a statement his own opinions, which were almost precisely those of his predecessor. He wrote: "Among one of the pressing needs of the University of Texas is an astronomical observatory. When the university opened in 1883, it was planned to add astronomy to the curriculum at an early date, but no courses in astronomy were given until 1899; and there is at the present time not even a student observatory on the campus—much less a research observatory with a large telescope such as are possessed by the Universities of California, Wisconsin and Chicago." Dr. Benedict and Mr. Calhoun worked happily with Dr. Hutchins and Dr. Struve to form a basis for the construction and joint operation of the observatory. Texas could by no means have supplied a staff, even had the bequest been greater, to equal that under the present arrangement. The university feels that it is honored and has benefited immeasurably by this association with the University of Chicago. With the staff of the Warner and Swasey Company, the builders of the plant, the University of Texas has enjoyed a most pleasant and satisfactory relationship throughout the performance of the task of design and construction. It is, therefore, a matter of the greatest satisfaction and an occasion of sincerest felicity that the Board of Regents makes for the University of Texas acceptance of the McDonald Observatory.

Dr. J. S. Plaskett, director emeritus of the Dominion Astrophysical Observatory at Victoria, B. C., described the principal features of the new mirror:

The important element of the optical equipment of the McDonald Observatory, which has just been accepted by the director and the chairman of the Board of Regents, is the main concave parabolic mirror having a diameter of 82 inches, a thickness of 12 inches and a focal length of 320 inches. While the telescope can and will be used with the principal mirror only, it should be stated for the benefit of non-astronomical listeners that the usefulness of the telescope would be seriously limited if auxiliary smaller mirrors, generally called Cassegrains, were not also available.

The purpose of the Cassegrain mirror is to increase the equivalent focal length of the telescope, and consequently the magnifying power, without increasing the length of the telescope tube. Such an increase would entail a large increase in the dimensions of the telescope and the size of the dome and would enormously increase the cost of the observatory. The surface of the Cassegrain mirror is convex of hyperbolic form and it is inserted, about 7 feet below the focus, in the converging cone of star light from the 82-inch mirror. The cone of light is hence made less converging and is reflected back towards the main mirror, in the most frequently used form passing through the central hole and forming an image of the star about a foot below the mirror cell. The Cassegrain mirror works on a similar principle to the rear negative element of a telephoto camera lens, which gives an enlarged image without increase of camera length.

This particular low power Cassegrain mirror, which is 28 inches in diameter, is attached to the central focussing sleeve at the upper end of the telescope tube and increases the equivalent focal length to 92 feet and the magnification 3.5 times. The focus, a foot below the mirror cell, is in the most convenient observing position and can be easily reached from the elevating platform in any position of the telescope. The star images can be observed visually, focussed on a photographic plate or on the slit of a spectrograph. It seems probable that the telescope will be used in this form for more than half the observing time.

The second high power Cassegrain mirror is 21 inches in diameter, is attached in the same position and increases the equivalent focal length to 155 feet and the magnification 5.8 times. The light from this Cassegrain mirror falls upon a plane mirror inclined at 45 degrees, which sends the beam centrally along the declination axis to the center of the polar axis. Here a second plane mirror, also inclined 45 degrees, sends the beam down the hollow polar axis forming the star image below the south end of the axis in a temperature controlled room where a powerful stationary spectrograph can obtain high dispersion spectra of the brighter stars. This is commonly called the Coudé form and the McDonald telescope is the first of this type of mounting with the tube at the side of the polar axis to be adapted for Coudé observations.

These different forms of the telescope all depend on the quality of the fundamental optical surface, the 82-inch parabolic mirror and, if it is inferior, only poor images can be obtained with any form of the telescope no matter how good the Cassegrain mirrors may be. Hence we come to consider the specified subject of these remarks—"Some Features of the New Mirror."

Practically every one knows in these days of automobiles that the penetrating parallel beam from the headlights is produced by a parabolic reflector with the light in the focus. Conversely a parallel beam falling on a parabolic reflector will make a bright spot or image at the focus and this is what occurs in a reflecting telescope when star light shines on the mirror. Although the star can not be less than twenty-five thousand billion miles distant, a figure readily appreciated in these days of swollen national debts, and may be a million miles in diameter, the beam of light falling on the mirror is so nearly parallel that no instrument however sensitive could detect any lack of parallelism.

This parallel beam of star light is reflected back from the mirror surface in a converging pencil to a focus at the top of the tube 320 inches above the mirror and forms there an image of the star. If light behaved as if it were shot off from the star as infinitely small particles in straight lines and if the mirror were perfect and the air perfectly steady, there would be a very minute circular image of the star one one hundred thousandth of an inch in diameter, quite invisible as a sensible disc of light even with the highest power eyepiece that could be used. Whatever the nature of light, and physicists are by no means so positive about it as they were thirty or forty years ago, it is certainly not transmitted according to simple geometrical rules. For this purpose, the formation of images by lenses or mirrors, light behaves as if it were transmitted by wave motion. The parallel pencil of light from the star in the case of a mirror is reflected back in a converging pencil but is also diffracted by the edge of the mirror cell forming a diffraction pattern at the focus. This pattern consists of a bright central disc surrounded by a series of bright and dark rings, although 97 per cent. of the light is concentrated in the central disc. This is sometimes called the spurious disc, as it is not the image of the star but the pattern produced at the image of a point source by the manner in which the light is transmitted.

The size of this diffraction disc depends upon the aperture and focal length of the objective and on the wave-length or color of the light and for visual light and the 82-inch mirror is slightly greater than one five thousandth of an inch, twenty times larger than the geometrical image. It is the size of this spurious disc which limits the resolving power of telescopes, as the images of a double star must be separated by the radius of the spurious disc before one can be sure of duplicity. It will be of interest to compute geometrically, without reference to wave theory or diffraction, the optical properties of the 82-inch mirror, and to compare the size of the geometrical image with the diffraction disc.

The quantitative tests were made in the optical shop of the Warner and Swasey Company under practically constant temperature conditions and consisted of measures, by means of an artificial star and knife edge, of the radius of curvature of 12 zones, 2½ inches apart, across the usable surface of the mirror. There were 22 individual measures of each of the 12 radii, 11 each by Mr. Lundin and myself, the probable error of the mean being about one thousandth of an inch for the inner zones and only half that for the more convergent outer zones.

A comparison of the measured radii with those computed theoretically from the properties of the parabola showed remarkably small deviations. Translated into departures of the foci of the zones from the mean focus of the 82-inch mirror, the average departure is only one thousandth of an inch, the maximum amount for an inner zone where the effect on the size of the image would be small is only five thousandths of an inch. There is a relatively simple method for changing these small deviations from the focus into departures of the surface of the finished mirror from the true parabolic curve. No part of the 82-inch mirror, nearly 5,000 square inches of glass, is so much as one millionth of an inch, seven tenths of one millionth, to be exact, from the true theoretical form. This is about one thirtieth of a wave-length of visual light, an indication of the perfection of the optical surface. It is usually considered that a deviation of the wave front of a quarter wave, and hence after the reflection a departure of the mirror surface of an eighth wave should give excellent definition. As the departure of the actual surface is only one fourth the allowable amount it should and does give superb definition.

The quality of the 82-inch mirror may be estimated from a different angle, the diameter of the star image geometrically computed from the measured deviations from the focus. Allowing for the outer zones sending more light to the image, the weighted mean diameter of the geometrical image is less than one six thousandth of an inch, 30 per cent. smaller than the spurious diffraction disc, and hence the aberrations will not enlarge the theoretical image. Further, the specifications called for an image not larger than 0.05 mm, two one thousandths of an inch, while the actual mean diameter is only one twelfth this limit. The diameter of a star image photographed with the 82-inch mirror under only average seeing conditions is 0.05 mm, 1.3 seconds of arc, which will undoubtedly be reduced to 1 second or smaller in good seeing conditions. Obviously the dancing about and spreading out of such a large diffusion disc as 0.05 mm would have markedly increased the photographic image and there can be no doubt that the superb quality of the 82-inch mirror will be of enormous advantage, enabling much fainter stars to be photographed and markedly shortening the exposures required for stellar spectra.

Finally, it will be of interest to make numerical comparisons of the magnitude of the aberrations of the 82-inch mirror with those of the Victoria, Delaware and Toronto telescopes, the only large reflectors whose aberrations have been published. The optical quality is expressed by the smallness of the Hartmann criterion "T," which is simply the mean diameter of the confusion circle in terms of the one hundred thousandth of the focal length. In the McDonald mirror "T" is 0.05 or the confusion circle is only one two millionth of the focal length. The criterion "T," the mean diameter of the geometrical image and the magnitude of the aberrations are 2½ times larger in the Victoria mirror, 3 times larger in the Delaware mirror, and 4 times larger in the Toronto mirror. The Cassegrain mirrors of the McDonald telescope have, I believe, an even greater margin of superiority over the others, and are of superfine quality, the photographic images in average seeing being only increased from 1.3 to 1.5 seconds of arc by the addition of a Cassegrain mirror.

There can be no question of the superb quality of the optical equipment of the McDonald Observatory, nor of the accuracy and great convenience in operation of the mounting of the telescope. The University of Texas and the director and staff of the observatory are very fortunate in possessing such unequalled facilities for extending our knowledge of the universe. They were also very fortunate in having a firm like the Warner and Swasey Company undertake the construction of the telescope and observatory building. No other firm has the facilities to make such an instrument, and I know of no other firm who would persevere in the determination to make this the best and most complete telescope possible without regard to the cost. Tribute should be specially paid, in this description of the optical parts, to the remarkable skill of Mr. C. A. R. Lundin, among the foremost of living opticians, who is in charge of the optical department of the company. It was his skill and experience in optical work and his determination to persevere in the figuring until even his exacting standards were fulfilled that was mainly responsible for the magnificent quality of the optical surfaces.

Professor Arthur H. Compton, of the University of Chicago, spoke on "The First of the Sciences," and outlined the close relation between astronomy and physics. This stirring address will doubtless be published elsewhere.

In conclusion, Dr. Homer P. Rainey, president-elect of the University of Texas, spoke as follows:

The opening of this observatory is an event of great significance to the scientific world, and one of just pride for the people of Texas. For astronomers it is an enlargement and a refinement of the instruments of their craft; it opens new possibilities of extending their chart and knowledge of limitless space. For the University of Texas it is another symbol of the rise of the university to a place of prominence in the world of science.

To the appreciation of one man for the glory of the starry universe in which he lived we are indebted for this magnificent instrument. W. J. McDonald, from his youth, had a profound interest in the wonders of nature which he observed round about him. Although we are told that he had a lively and intelligent interest in animal life, he was especially engrossed in botany and astronomy, and as time went on his love for astronomy overshadowed his other scientific interest. His study of the heavens became so consuming that he left all the accumulations of his life's work for the building and equipping of an astronomical observatory. Mr. McDonald wanted it to be an instrument of such size that it would enable astronomers to peer farther into the universe than man had ever been able to do before.

He once humorously remarked to his Negro barber that some day a telescope would be constructed that would enable an astronomer to see the gold-paved streets of the New Jerusalem. While this telescope which he has made possible can not be expected to reveal to us a celestial city with streets of gold and gates of pearl, it will undoubtedly bring within our vision the vastness and glory of a universe yet unknown that will be more inspiring than that one seen by the disciple on the Isle of Patmos. They very reality of the universe which this instrument will reveal will be far more liberating to the human mind and spirit than the mere fruits of imagination, however inspiring they may have been.

Man's knowledge of the stars has always been a central feature of his poetry and his religion. A contemplation of them has always had what Robert Louis Stevenson called "a serene and gladsome influence on the mind." "The greater part of poetry," he said, "is about the stars; and very justly, for they are themselves the most classical of poets." From time immemorial the stars have had a fascination for man's mind far greater, perhaps, than any other part of the universe. Man's thoughts are never so lofty and pure as when he is in some quiet and serene place gazing into the heavens and listening to "the music of the spheres."

Mr. McDonald, therefore, has made far more than a contribution to the advancement of science. He has made possible the enlargement and the uplifting of the soul of man, and this is a gift that surpasses all others.

In our rejoicing over this munificent gift from Mr. McDonald we should not fail to recognize also the splendid part which former President H. Y. Benedict had in the erection of this observatory. He was himself an astronomer and he understood the requirements of an astronomical observatory. He had an exceptional grasp of the entire situation, and it is because of his understanding that the observatory is located in the most advantageous spot in Texas.

There is perhaps no better place in the entire country for an observatory. Texas has long been famed as a land "where the skies are not cloudy all day," and in this particular region there are more cloudless days than in almost any other place. Furthermore, the atmosphere in this region is as clear as any that can be found, which will be a marked advantage in observations. There is also another favorable feature of this "Olympian station." It is far from even "the whispering rumor of a train" or other disturbances, and where, in the evening, the world falls into a dead silence conducive to observation, reflection and contemplation. All these factors combine to make this a most fortunate location for the observatory.

Another unusual feature of this entire enterprise is the fact that for thirty years it is to be operated cooperatively by the University of Texas and the University of Chicago. President Hutchins, who conceived this cooperative relationship, has already spoken of this situation. So far as I know, this relationship is unique and is, I believe, a very fortunate one. This sort of cooperation suggests other similar possibilities. It happened in this case that the University of Texas had the funds for an observatory but did not possess a faculty in astronomy, and a telescope is of very little use without astronomers to operate it. On the other hand, the University of Chicago had an outstanding faculty, but was in need of more and better equipment for observation. Speaking for the University of Texas, I can assure President Hutchins and the trustees of the University of Chicago that we are delighted with this arrangement, and we anticipate many fine values to accrue from it over and above the magnificent scientific research which will be done here. We pledge the University of Chicago our complete cooperation to the end that the finest possible results may be realized through this joint enterprise.

We are here to dedicate this observatory to the most ancient and purest of all the sciences. In doing so, may I express the hope that this observatory will stand as an enduring symbol of the insatiable desire of man to discover the secrets of the universe, and that it may also stand as a symbol of the freedom of man's mind to explore the boundless areas of truth without any restrictions whatsoever.

To these ideals I dedicate the McDonald Observatory in the name of the University of Texas, and now declare it open for research.

The dedication was followed by a symposium, sponsored by the Warner and Swasey Company, on "Galactic and Extragalactic Structure," the program of which was given in SCIENCE for March 3, 1939. The majority of the symposium papers will be published in the *Astrophysical Journal*.

BIOPHYSICS AND HYDRAULIC ENGINEERING

By Dr. J. F. HERRICK

DIVISION OF EXPERIMENTAL MEDICINE, THE MAYO FOUNDATION, ROCHESTER, MINNESOTA

How many hydraulic engineers have had their attention attracted to the circulatory system of man and animals? Perhaps it is the most ingenious hydraulic engineering feat in nature. Few investigators have taken a broad glance at the circulatory system from an engineer's point of view.

The purpose of the present paper is to describe some fundamental problems which confront the biophysicist who is interested in the circulatory system. These problems require a thorough understanding of applied fluid mechanics. The hydraulic engineer is better prepared than the average biophysicist to attack such problems.

In the blood vascular system we have a circulatory system in which the average pressure is maintained at a relatively constant value unless an emergency alters it, whereupon a mechanism is called into action which promptly restores or attempts to restore normal conditions. When certain defects develop, the normal pressure becomes inadequate for performing the necessary functions. Under these conditions the system operates at a higher pressure, thus introducing its compensatory mechanisms. The various mechanisms whereby the circulatory system accomplishes its functions of (1) supplying nutritive materials to different parts of the body, (2) eliminating the waste products of catabolism, (3) regulating the pressure, (4) regulating the temperature and (5) distributing hormones and various chemicals to their proper depots, would fascinate any hydraulic engineer.

The particular problems which confront us at the moment and which I wish to describe have to do with pressure and with flow and will be treated separately.

PRESSURE

Methods of measurement. The ideal method for measuring blood pressure is still lacking. True enough, the measurement of the pressure is an everyday affair. The universally used method is an indirect one where pressure is applied in order to cause a complete collapse of the blood vessel. If arterial pressure is being observed, both systolic and diastolic pressures are recorded. These pressures are those which occur simultaneously with certain arbitrary sounds heard over the given artery by means of a stethoscope on releasing the collapsed vessel. I shall not take time to describe the details of the apparatus and the technique used in this (auscultatory) method. The standard method which is used experimentally consists in cannulation of a given blood vessel and proper communication with a suitable manometer.

The ideal method would be one which permits continuous recording of blood pressure—an automatic method, so to speak. The indirect method obviously does not permit continuous observation. The direct method makes constant recording impossible because there is no anticoagulant which keeps blood from clotting for an indefinite period. In addition, the isolation and cannulation required also limit the time of recording.

One might imagine a possible relation between the pressure on the wall of a partially closed blood vessel and the true pressure of the contained blood. If such a relation could be found to be consistent, the pressure on the wall of the vessel might be recorded by using the principle of piezoelectricity. Such a method as this would permit continuous observation of blood pressure.

To put the problem in question form: how would you measure the pressure of a coagulable fluid circulating in a closed elastic system without either direct communication with the fluid or completely collapsing the elastic "pipe"?

Differential pressure. Owing to the action of the pump in this circulatory system the pressure varies throughout the cycle of the pump (cardiac cycle). When the pump is contracting, the pressure in the system is maximal and is named systolic pressure. When the pump has finished its contraction and is temporarily in a state of rest, the pressure in the system is minimal and is called diastolic pressure. One may also observe the average pressure throughout the cardiac cycle. As in other hydraulic systems there is a gradual decrease in the average pressure throughout the system from the output to the input sides of the pump. The term pressure-gradient characterizes this well-known variation. However, if one considers the systolic pressure only, an interesting phenomenon presents itself—the systolic pressure in the leg artery (femoral artery) is about 30 to 50 mm of mercury higher than that in the neck artery (common carotid artery) in spite of the fact that the leg artery is much further away from the pump than the neck artery. This difference in systolic pressure exists even when the body is lying in a horizontal plane. This observation is a well-known fact among those measuring blood pressures. However, no one knows why. Many explanations have been offered, all of which reduce to three basic principles:

(1) A transformation of kinetic energy into pressure energy—a Pitot tube effect. The change of momentum of the moving fluid acting in addition to the lateral pressure causes an increased pressure. Pitot tubes are so constructed as to make use of this effect in measuring velocity of fluids.

(2) A water hammer effect. The more or less abrupt change in velocity that the blood in the femoral artery undergoes gives rise to pressure waves similar to those observed in water pipes. The velocity in the common carotid artery does not change so abruptly.

(3) An effect due entirely to the elastic property of the "pipes" which brings about a higher systolic peak in the femoral than in the carotid artery.

Text-books on applied fluid mechanics indicate that one could distinguish between a Pitot tube effect and a water hammer effect. If the Pitot tube effect exists then the difference in pressure indicated by the Pitot tubes is proportional (approximately) to the square of the velocity of flow. If the effect is due to a water hammer, then the relationship between change in pressure and change in velocity will be linear.

The solution of the problem calls for accurate methods of measuring pressures and velocities of blood. The biophysicist and physiologist can measure pressures very accurately. However, there is not, at present, a method of measuring blood velocity which would be entirely satisfactory for solving this problem.

The physiologists have known about this interesting phenomenon of differential systolic pressures for almost fifty years. A completely satisfactory explanation of the phenomenon has never been attained.

FLOW

Methods of measurement. A direct method of measuring anything is always preferred from the point of view of accuracy. However, in the measurement of blood flow an indirect method is preferred if one wishes to maintain normal physiologic conditions in studying the characteristics of flow. The peripheral circulatory system is so close to the condition of turbulence that any interference with it may produce turbulence, especially on the arterial side. A continuous indirect method is the ideal method since it preserves normal physiologic conditions, providing the indirect method does not require operative procedures which alter the normal conditions. When one considers the physiologic variation, he realizes that to develop an absolutely accurate method of measuring blood flow would be a waste of time even if it were possible. One learns in his study of physics, as well as of other sciences interested in measurement, that the accuracy of the method should conform to the conditions of the problem. It is as ridiculous to have too accurate a method as it is to have too inaccurate a method in certain studies. One's common sense must be used in all cases.

In order to use certain indirect methods properly, a knowledge of the character of flow is absolutely essential. The method may be very reliable as long as the flow is laminar or streamline but may be 100 or 200 per cent. inaccurate when the flow becomes turbulent.

To describe the various methods of measuring blood flow developed since the time of Volkmann would require the space of a fair-sized book. It is sufficient to say that most methods consist in the application of well-known physical principles such as the Venturi meter, rate of cooling, change of electric resistance with change of temperature, electromagnetic induction, the hydrometric pendulum and other devices.

Character of flow. The method of measuring flow which I have used for several years is dependent on the type of flow. I am much interested in the question. Is the blood flowing in a given vessel streamline or turbulent?

This paper is written primarily with the hope that the hydraulic engineer will be able to offer suggestions for answering the question or better yet that he will want to take an active part in the study of this interesting problem.

So far as I know, two methods are available for answering this question, a theoretical method and a practical one.

Theoretical. "As has long been known from the classical researches of Osborne Reynolds and others, the steady isothermal flow of a fluid through a long straight pipe may occur by one of several mechanisms. When the dimensionless Reynolds number $\frac{DV\rho}{\mu}$ is sufficiently small, the individual particles of fluid flow in straight lines parallel to the axis of the pipe, without appreciable radial component as shown. . . . This type of motion is variously described as streamline, straight-line, viscous and laminar. At sufficiently high values of Re, the motion is said to be turbulent, because of the presence of innumerable eddies or vortices present in the central portion of the pipe, as indicated. . . ."[1]

In the preceding quotation Re stands for Reynolds number, which is calculated from the formula $\frac{DV\rho}{\mu}$, where

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[1] W. H. McAdams, "Heat Transmission," pp. 99–100. New York, McGraw-Hill Book Co., Inc., 1933.

D = diameter (inside) of pipe
V = average velocity
ρ = density
μ = viscosity

One can calculate the Reynolds number for blood from the above formula and determine whether the flow is in the streamline or turbulent range. According to such calculations for, say, the femoral artery of a dog, the flow is below the critical value for turbulence. However, I feel that it may, at times, become turbulent.

Practical. One may make an exact model of the hydraulic system in question and directly observe the nature of flow by introducing a contrasting color to the fluid at the desired location. This would be rather difficult to do for the problem in question. According to Franklin[2] and others nature offers conditions for the direct observation of the character of blood flow in certain veins. The blood flowing into the abdominal vena cava from the reproductive organs of certain animals is like arterial blood in color and serves as an excellent contrast to the venous blood already present in this vein. According to observations the arterial-like blood flowing into the vena cava at this site continues in its own channel without mixing with the blood already present. This indicates a streamline type of flow. The vein has a thin wall so that the contrasting color may be easily observed. The artery is not so transparent.

Artificial circulatory systems have been made and have proved useful in the perfusion of various organs with blood. I have observed that small constrictions in such systems give rise to turbulent flow. The degree of turbulence produced experimentally is dependent on the type of constriction. Blood vessels *in situ* may have such constrictions under certain conditions, for example, arteriosclerosis and coarctation.

It would be helpful to know exactly the nature of the flow of blood in any given blood vessel at any time. The character of the flow in the great vessels near the heart as well as that in the coronary vessels would be particularly interesting. Attempts have been made to study this problem in acute experiments where a general anesthetic, artificial respiration and anticoagulants are required. All these alter the normal conditions profoundly, so that one can not say the results of the study are maintained in the normal intact animal.

The hydraulic engineer usually works with fairly homogeneous fluids flowing in rigid pipes, so that a problem in which blood, a heterogeneous fluid, circulates in an elastic closed system might present new difficulties.

OBITUARY

RECENT DEATHS AND MEMORIALS

DR. CHARLES HORACE MAYO, emeritus professor of surgery in the Medical School of the University of Minnesota and in the Graduate School of the Mayo Foundation; founder, with his brother, Dr. William James Mayo, of the Mayo Clinic at Rochester, Minn., died on May 26 in his seventy-fourth year.

DR. WITMER STONE, emeritus director of the Academy of Natural Sciences of Philadelphia and a member of its staff since 1891 as conservator of ornithology and curator of vertebrates, died on May 23 in his seventy-third year.

ARTHUR E. WELLS, professor of metallurgy at Harvard University from 1926 to 1931, director of the American Cyanamid Company of New York, died on May 24. He was fifty-five years old.

DR. J. EDMUND WOODMAN, professor emeritus of geology at New York University, died on May 19 at the age of sixty-five years.

WILLIAM H. KAVANAUGH, for twenty-three years professor of experimental engineering at the Towne Scientific School of the University of Pennsylvania, died on May 6 in his sixty-sixth year.

FRANK W. DURKEE, since 1907 head of the department of chemistry at Tufts College, died on May 21 at the age of seventy-seven years.

PROFESSOR WILLIAM L. HUNTER, head of the department of industrial arts at the Iowa State College, died on May 23. Mr. Hunter had been a member of the faculty of the Iowa State College since 1927, having previously taught at the State University of Iowa and at the Bradley Polytechnic Institute.

DR. MAURICE BRODIE, laboratory director of Providence Hospital at Detroit, Mich., for the last two years, died on May 9 at the age of thirty-six years.

SIR FRANK DYSON, from 1910 to 1933 Astronomer Royal of England, previously from 1905 to 1910 Astronomer Royal of Scotland, died while on a voyage from Australia to South Africa on May 25. He was seventy-one years old.

DR. YOJIRO WAKIYA, the Japanese ichthyologist, was killed by an electric car near Tokyo, on April 21, at the age of sixty-seven years. He was known particularly for his studies of the Carangidae, Salangidae and Salmonidae of the Japanese Empire, but also published investigations on many other groups of fishes and on oysters. For many years he was director of the fisheries institute at Fusan, Chosen, which he developed into a leading center of ichthyological and fisheries research.

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[2] K. J. Franklin, "Respiration and the Venous Return in Mammals." In "A Monograph on Veins," pp. 236–267. Springfield, Charles C Thomas, 1937.

A CORRESPONDENT writes: "It is with deep regret that we record the untimely death of Dr. I. C. Wen, which occurred in the Peiping Medical College Hospital on Monday morning, April 17, after a prolonged illness. Dr. Wen was born on October 16, 1899, a native of Hupeh. He graduated from Tsing Hua College in 1922. Subsequently he took his Ph.B. in 1924 and Ph.D. in 1927 at the University of Chicago. He became a laboratory assistant in neurology in 1926–1927 at the University of Chicago and a Rockefeller Foundation fellow in anatomy in the department of anatomy at the Johns Hopkins Medical School in 1927–29. Dr. Wen was a member of Sigma Xi. Upon his return to China, Dr. Wen joined the Peiping Union Medical College in 1929, first as assistant in anatomy and then associate in 1931 and assistant professor of anatomy from 1934 until his death. Dr. Wen was a brilliant student in the fields of embryology and neurology."

A PLAQUE was unveiled recently at the Ohio State University in honor of Dr. John A. Bownocker, who died on November 2, 1928. At the dedication services Dr. Charles Foulk, of the department of chemistry, and Dr. Wilber Stout, successor to Dr. Bownocker as state geologist, were the principal speakers. Dr. J. Ernest Carman, of the department of geology, formally presented the plaque to the university. It was accepted by Acting President William McPherson. The tablet, the work of Professor Erwin F. Frey, of the department of fine arts, carries this inscription: "John Adams Bownocker, 1865–1928, BSC 1889, DSC 1897, Ohio State University, Professor of Geology Ohio State University 1898–1928, State Geologist Geological Survey of Ohio 1906–1928. The consuming interests of his life were his native state of Ohio, its geology and its university. He gave to them 30 years of devoted service as teacher and geologist. To Ohio State University he bequeathed his entire estate as an endowment for the work of the department of geology. To his students and his colleagues he left the memory of a rugged unswerving character, rough hewn like the rocks of his own geology."

SCIENTIFIC EVENTS

THE LAKE LABORATORY OF THE OHIO STATE UNIVERSITY

THE Lake Laboratory of the Ohio State University on Gibraltar Island near Put-in-Bay has now a year-around program, with continuous study of problems important to the Lake Erie fishing industries. Formerly the laboratory was open only in the summer for courses in advanced biology. Dr. Thomas H. Langlois is director of the laboratory, which has a special staff of instructors and lecturers.

The laboratory serves as headquarters for administration of the fisheries of Ohio, with Dr. Langlois as chief of the Bureau of Fish Management and Propagation of the Ohio Division of Conservation. The operation of twelve inland fish farms is directed from there, fish management agents from eleven districts report to Dr. Langlois, and commercial fishermen make reports of their catches to the laboratory.

Studies of the trends of the fisheries and the success of the fishermen thus are combined with studies of the life-histories of important species, to the end that the laboratory "may discover the factors limiting the abundance of important species of fish and point the way toward an effective conservation program."

Three quarters of the year are devoted to this phase of its work. In the summer the laboratory turns its attention to courses for students in advanced biology. Provision has been made this summer for living quarters for couples and small families, making it possible for students to take their families with them to the lake.

The staff, in addition to Dr. Langlois, includes Dr. Charles F. Walker and Dr. David C. Chandler, who work at the laboratory all the year. Several other members of the faculty of the Ohio State University will work there during the summer. Dr. Ralph V. Bangham, Wooster College; Dr. William F. Hahnert, the Ohio Wesleyan University, Delaware; Dr. Bertil G. Anderson and Dr. Earl L. Core, both of Western Reserve University, Cleveland, will also join the staff of the laboratory. There will be week-end lectures on the bird-life of the lake regions.

Expansion of the program of the lake laboratory has come as a result of an agreement completed last year between the university and the Ohio Division of Conservation, whereby the laboratory assumes responsibility for the division's fisheries research program. In return the conservation division has helped to provide new living quarters for faculty and students, and conservation hatcheries have been made available to the laboratory.

THE BATTELLE MEMORIAL INSTITUTE

CONTRACTS have been let by the Battelle Memorial Institute, Columbus, Ohio, for the construction of a new research laboratory to take care of the expanding volume of industrial research.

Clyde E. Williams, director of the laboratory, points out that research expenditures by industry are growing and that the increased laboratory and office space at Battelle have been made necessary by the growing research activity in metallurgy, fuels, ceramics and chemistry.

The new construction consists of a wing extending from the end of the present main building that will provide approximately 50,000 square feet of space on five floors. In this will be chemical and metallurgical laboratories, photographic and metallographic departments, physics laboratories and a large industrial laboratory.

Provision is being made for the relocation and expansion of the mechanical testing laboratory. A new 200,000-pound tensile testing machine is to be purchased to keep pace with developments in the field of metals. Constant temperature and controlled humidity rooms will be provided for chemical and metallurgical studies. The auditorium is being enlarged to increase its seating capacity and additional administrative office space will be available on the ground floor. The research laboratory space in the main building will be practically doubled.

This is the second time in the short history of the institute that space requirements have led to new construction. Less than two years ago a four-story building housing an experimental foundry and ore-dressing and coal-preparation laboratories was completed and put into service. The main building itself was occupied and work began in the latter part of 1929. The staff now numbers about 180.

The Battelle Institute was established and endowed by the wills of Gordon Battelle and his mother, Annie Norton Battelle, of Columbus, to encourage and conduct industrial research. It carries on fundamental and applied research in ferrous and non-ferrous metallurgy, ceramics, physics, organic and inorganic chemistry, fuels, coal preparation and utilization, ore-dressing and materials concentration. Work is done both with its own funds and for industrial sponsors.

The new wing will be of concrete and brick construction, conforming with the present main building. It is to be 60 feet by 150 feet in plan, with five full floors and a basement extension below ground level. The addition will convert the present L-shaped structure into a U, with the new wing some 30 feet longer than the old. Construction will begin at once, and it is expected that the new wing will be ready for use by the first of next year.

THE FOOD TECHNOLOGY CONFERENCE AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

The second Food Technology Conference will be held at the Massachusetts Institute of Technology at Cambridge from June 28 to July 1 under the auspices of the Division of Food Technology and Industrial Biology.

Like its predecessor this conference will deal with the broad aspects of the subject, but special attention will be directed to quality control, food packaging technology, food engineering and refrigeration. Consideration of the specific relation of trained food technologists to the food industries will be given special attention. In addition to members of the institute authorities in food industries and food research laboratories of the United States, Canada and possibly from other countries will be included among the speakers.

The opening session will be one of two particularly devoted to quality control. Sessions will follow relating to the engineering aspects of food technology; a joint session with the American Institute of Baking Engineers on recent developments in baking and associated food industries; a symposium on food packaging technology covering recent developments in the packing of foods in tin, glass, transparent films and rubber latex; and a symposium on Foods and Refrigeration in cooperation with the American Society of Refrigerating Engineers.

Among the guest speakers who are expected to make keynote addresses are Clarence Francis, president of General Foods; Dr. H. A. Baker, president of the American Can Company; President Karl T. Compton, of the Massachusetts Institute of Technology; J. L. Kraft, president of the Kraft-Phenix Company; Dr. O. E. Baker, of the U. S. Department of Agriculture; Dr. L. V. Burton, editor of *Food Industries*, and Professor W. V. Cruess, of the University of California.

A diversified program of entertainment is planned, which will include special luncheons, a barbecue held at the Dewey and Almy plant, an evening at the celebrated Boston Symphony "pop concert" and a banquet at the New Ocean House on the seashore at Swampscott, which will conclude the program of Friday. There will probably be a Saturday morning program, following which ample time will be left free for the proposed organization of an association of food technologists.

The present indications are that the attendance at the conference will be as large as in 1937 when over 600 were registered. Dormitory facilities for those attending the conference will be available in the Senior House of the Massachusetts Institute of Technology at a cost of $1.00 per night. This year there will be a registration fee of $2.50 for all in attendance. Applications for registration cards should be made in advance to Professor B. E. Proctor, Massachusetts Institute of Technology, Cambridge, Mass.

THE STANFORD UNIVERSITY MEETING OF THE PACIFIC DIVISION OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE twenty-third annual meeting of the Pacific Division of the American Association for the Advancement of Science will be held this year at Stanford University from June 26 to July 1. Sixteen scientific organizations on the Pacific Coast are participating actively by holding scheduled sessions throughout the week; among them are the astronomers, botanists, chemists, ecologists, economic entomologists, ichthyologists and herpetologists, geographers, meteorologists, naturalists, physicists, plant pathologists, plant physiologists, the Society for Experimental Biology and Medicine and the Western Society of Soil Science. Members of associated societies not formally participating have been invited to take part by attending or presenting papers at the scheduled sessions.

The general sessions will open on Tuesday morning, June 27, with a symposium on "Radiation and Life." This will include an address by Dr. W. V. Houston, of the California Institute of Technology, on "Radiation"; "Radioactive Elements as Tracers in Metabolic Studies," by Dr. John H. Lawrence, of the University of California; "Radiation and the Hereditary Mechanism," by Dr. M. Delbruck, of the California Institute of Technology, and "Medical Applications," by Professor Robert R. Newell, of the Stanford University Medical School.

An afternoon session on "Reviews of Current Research" is next on the program. Professor J. W. McBain, of Stanford University, will speak on "Recent Advances in Colloid Chemistry." An address by Professor A. R. Davis, of the University of California, will follow on the subject of "Mineral Metabolism in Plants." Professor Henry Borsook, of the California Institute of Technology, will speak on "Biological Oxidations and Reductions," and Dr. J. W. Macfarlane, of the University of California, will discuss "Research on Personality Development."

A general reception for members and guests of the division and its associated societies will follow this meeting. There will also be three evening addresses during the week. The first, on Tuesday, June 27, will be given by Professor S. J. Holmes, president of the Pacific Division, American Association for the Advancement of Science, and will deal with "Darwinian Ethics and Its Practical Applications." On Wednesday evening Professor V. Gordon Childe, of the University of Edinburgh, will give an illustrated lecture on "The Neolithic Economy in Northwestern Europe," and on Thursday evening Professor J. D. Bernal, of the University of London, will speak on "The Structure of Protein Molecules."

Among the numerous symposia organized by the participating societies, mention might be made of the following: "Dams and the Problem of Migratory Fishes," "Recent Contributions of Botany and Ecology to Society," a symposium on the teaching of plant pathology, "Availability of Nutrients in Soils to Plants," "Translocation of Solutes in Plants," "Growth," "Native Plants of Western North America Offering Exceptional Material for Botanical Research," "New Ultra-high-frequency Apparatus" and "Methods and Results of X-ray Structure Determination." The last-mentioned will include J. D. Bernal, M. L. Huggins, H. Mark, O. L. Sponsler and Dorothy M. Wrinch as speakers.

The meeting of the Pacific Division will be followed by a symposium commemorating the enunciation of the cell theory (July 1 to 5), and by the Sixteenth National Colloid Symposium (July 6 to 8). Both will be held at Stanford University.

J. MURRAY LUCK,
Secretary

THE ELECTION OF FOREIGN MEMBERS OF THE ROYAL SOCIETY

AT a recent meeting of the Royal Society the following were elected to foreign membership in the society:

Professor Walter Bradford Cannon, professor of physiology in Harvard Medical School. Distinguished for (a) his x-ray investigations of the movements of the alimentary canal; (b) his analysis of the mechanism and conditions of excitation of the suprarenal gland and (c) his work on the chemical transmission of impulses in peripheral nerves as shown by the sympathetic system.

Professor Herbert Freundlich, University of Minnesota. Distinguished for his researches in colloid chemistry and colloid physics.

Professor George Von Hevesy, research professor in the Institute of Theoretical Physics, Carlsberg Laboratory, Copenhagen. Distinguished for (a) his work in experimental chemical physics, particularly the use, for the solution of biological and chemical problems, of radioactive and isotopic substances as indicators; (b) for his discovery of hafnium and (c) for his geochemical researches and for his work on isotopes and their separation.

SCIENTIFIC NOTES AND NEWS

FOREIGN members of the Linnean Society of London have been elected as follows: Dr. William King Gregory, curator of comparative anatomy and ichthyology of the American Museum of Natural History and professor of paleontology at Columbia University; Dr. Alfred Rehder, curator of the Herbarium, Arnold

Arboretum, and associate professor of dendrology at Harvard University; Dr. William Albert Setchell, emeritus professor of botany at the University of California; Professor Alfred Ernst, director of the Institute of General Botany of the University of Zurich, and Dr. William Marins Docters van Leeuwen, formerly director of the Botanic Gardens, Buitenzorg.

PROFESSOR ELIOT BLACKWELDER, of Stanford University, has been nominated by the council for president of the Geological Society of America, and Professor Douglas Johnson, of Columbia University, has been nominated first vice-president.

DR. ELMER D. MERRILL, Arnold professor of botany and administrator of botanical collections of Harvard University and director of the Arnold Arboretum, has been appointed by the organizing committee of the seventh International Botanical Congress, to be held in Stockholm in 1940, as one of the presidents of the section of taxonomy and nomenclature and as president of the subsection for nomenclature. He served in similar capacities at Cambridge in 1930 and at Amsterdam in 1935.

DR. ROBERT CUSHMAN MURPHY, of the American Museum of Natural History, has been elected an honorary member of the Royal Hungarian Institute of Ornithology.

AMONG honorary degrees to be conferred at the annual commencement exercises of Temple University on June 15 will be the doctorate of humane letters on Dr. Victor George Heiser, who retired in 1934 as associate director of the International Health Division of the Rockefeller Foundation.

THE Herty Medal for 1939 has been presented by the department of chemistry of the Georgia State College for Women at Milledgeville, Ga., to Frank K. Cameron, of the University of North Carolina, in recognition of his research on cellulose in cotton.

DR. GEORGE GRANGER BROWN, professor of chemical engineering at the University of Michigan, received on May 16, in recognition of his work on thermodynamics and distillation, the 1939 William H. Walker Medal presented at the Akron, Ohio, meeting by the American Institute of Chemical Engineers. The award is made annually for "outstanding articles published by the institute during three years prior to the award."

AT the annual meeting of the Board of Trustees of *Biological Abstracts*, held in Washington on April 25, the following officers were elected: Dr. George W. Hunter, III, *president;* Dr. Anton J. Carlson, *vice-president;* Dr. Alden B. Dawson, *treasurer;* Dr. Conway Zirkle, *secretary.* The executive committee for the current year consists of Dr. George W. Hunter, III, *chairman;* Colonel Arthur Parker Hitchens and Dr. Alden B. Dawson.

DR. WILLIAM W. HUTCHINSON, of Los Angeles, was named at St. Louis president-elect of the Associated Anesthetists of the United States and Canada. In elections of two associated organizations, Dr. Hugh Cunningham, of Milwaukee, was named president-elect of the Mid-western Association of Anesthetists, and Dr. R. Douglas Sanders, of Louisville, president-elect of the Southern Association of Anesthetists.

A DINNER in honor of Professor Francis Ramaley, who retires this year after forty-one years as head of the department of biology of the University of Colorado, was given on April 22. Some seventy former and present members of the staff and graduate students were present. Professor Aven Nelson spoke on his reminiscences of early botanical study in the Rocky Mountain region. Professor Ramaley was presented with a dissecting binocular microscope and a volume of congratulatory letters.

PROFESSOR W. L. BLIZZARD, since 1919 head of the department of animal husbandry of the University of Oklahoma, has been appointed dean of the School of Agriculture and director of the Experiment Station.

PROFESSOR HENRY P. RUSK, head of the department of animal husbandry since 1923 and a member of the staff for twenty-nine years, has been appointed dean of the College of Agriculture of the University of Illinois, director of the Agricultural Experiment Station and director of the Extension Service in Agriculture and Home Economics. He will succeed Dr. J. C. Blair, who will retire on September 1.

DR. J. D. COCKCROFT, lecturer in physics in the University of Cambridge and fellow of St. John's College, has been elected Jacksonian professor of natural philosophy.

DR. DOROTHY GARROD, daughter of the late Sir Archibald Garrod, Regius professor of medicine at the University of Oxford, has been elected to the Disney professorship of archeology at the University of Cambridge in succession to Dr. E. H. Minns, who retires in October. Dr. Garrod is director of studies in archeology and anthropology at Newnham College, and is known for her excavations in the Near East and at Gibraltar.

DR. JOHN H. PARKER, professor of agronomy at the Kansas State College, Manhattan, has resigned to become director of the Kansas Wheat Improvement Association, with headquarters in Manhattan. He has been succeeded at the college by L. P. Reitz, of the U. S. Department of Agriculture.

DR. LEONARD A. MAYNARD, professor of animal nutrition, and Dr. John K. Loosli have been placed in charge of a five-year project on the nutrition of animals, recently inaugurated at Cornell University by the United States Biological Survey. The initial object of the project is to determine proper foods for fox and mink, as an aid to fur farmers.

Dr. Hugh S. Cumming, surgeon-general of the United States from 1920 to 1936, returned on May 24 on the liner *Manhattan*, of the United States Lines, after attending, as medical delegate, assemblies in Geneva and Paris.

Dr. T. G. Yuncker, professor of botany at DePauw University, is spending next year in the south Pacific area making collections and studying the flora of southeastern Polynesia on a Yale-Bishop Museum fellowship. He sails in July for Honolulu and later will go to the Tongan archipelago, where he plans to spend several months.

Dr. Frank E. Egler, assistant professor of ecology and taxonomy at the New York State College of Forestry, is sailing on June 3 from New York City on the *S. S. Nerissa* for Martinique. He will spend the summer on botanical investigations in the French Antilles, with the cooperation of Dr. Henri Stehle, director of the Tivoli Experiment Station. The work will include an ecological reconnaissance of the vegetation in semi-arid regions with reference to soil, water and forage conservation. These studies are in line with the Hawaiian investigations of Dr. Egler, who was Yale University-Bishop Museum fellow in 1936–1937.

Dr. A. M. Chickering, professor of biology and chairman of the division of science and mathematics in Albion College, Michigan, has been on leave studying his collections of Central American spiders at the Museum of Comparative Zoology, Harvard University. A few weeks also were spent in the Osborn Zoological Laboratory, Yale University, as guest of the laboratory and of Professor Alexander Petrunkevitch. On June 14, with his son as assistant, he expects to sail for work on spiders in Panama. Dr. G. W. Prescott, of Albion College, with assistants, will join him later in the summer, primarily for an investigation of the algae of the Panama Canal and associated waters.

Dr. Oskar Kraus, director of the Brentano Institute of Prague, has been appointed Gifford lecturer in natural theology at the University of Edinburgh for the academic year 1940–41.

Former President Herbert Hoover, honorary member of the American Society of Mechanical Engineers, will give an address before the society at the Golden Gate International Exposition, on Engineers' Day, July 13. He will discuss the contributions that have been made by engineering to human welfare. Dr. Rodolfo E. Ballester, director of the Irrigation Department of Argentina, S. A., will give the Calvin W. Rice lecture. He will speak on hydraulics and how engineers of the United States may better cooperate with those of South America. He is expected to arrive in New York on June 26.

Dr. A. J. Carlson, professor of physiology at the University of Chicago Medical School, gave an address on "Science and the Common Life" at the dedication of the new building of the May Institute for Medical Research of the Jewish Hospital in Cincinnati.

Dr. Lewis John Stadler, principal geneticist of the Office of Cereal Crops and Diseases of the Bureau of Plant Industry, gave the ninth series of Frank Azor Spragg Memorial Lectures at the Michigan State College on May 16, 17, 18 and 19. These lectures were established by the Michigan State Board of Agriculture in 1930 as a memorial of the contributions to Michigan agriculture by Frank Azor Spragg, plant breeder at the Michigan Station from 1906 to 1924.

In the symposium on "The Cell and Protoplasm" to be given at Stanford University on July 1, the program of which was printed in the issue of Science for May 19, the paper entitled "The Cell Wall and Protoplasm" is to be given by I. W. Bailey, of Harvard University, *not* by L. H. Bailey.

The Royal Swedish Academy of Science is this year celebrating the two hundredth anniversary of its founding on June 2, 1739.

The American Malacological Union will hold its ninth annual meeting in the Royal Ontario Museum of Zoology, Toronto, from June 20 to 23.

The forty-first annual meeting of the Medical Library Association will be held on June 27, 28 and 29 at the Academy of Medicine of Northern New Jersey, Newark. The program will include addresses, discussions and demonstrations on library procedure, medical history and literature. This association consists of about two hundred and fifty of the medical libraries of the United States and Canada, together with their librarians and a group of supporting members, who are chiefly physicians interested in medical literature and libraries. The officers of the association are as follows: *President,* James F. Ballard, Boston; *Vice-president*, Dr. George R. Minot, Boston; *Secretary,* Miss Janet Doe, New York; *Treasurer,* Miss Louise D. C. King, Baltimore, and *Chairman of Executive Committee,* Miss Marjorie J. Darrach, Detroit. Every one is invited to attend who is interested in a wider knowledge of medical literature and in the development of medical libraries.

The British Association for the Advancement of Science held the first public meeting in London of the new division for the Social and International Relations of Science at the Royal Institution on May 25. Professor Ernest Barker, professor of political science at the University of Cambridge, and Sir Daniel Hall, formerly chief scientific adviser to the Ministry of Agriculture, were the principal speakers. Sir Richard Gregory was in the chair. The object of the meeting was to show how science and society are "out of gear," and to explain the nature of the task that the division has undertaken in trying to bring about an adjustment. Professor Barker spoke on "The Impacts of Science on Society," and Sir Daniel Hall on the application of science to agriculture. Sir Richard Gregory dealt with the work of the division. The meeting was intended for workers in every branch of science with a view to securing their interest and cooperation in the work of the division, which at present is concerned with questions of nutrition, population, social psychology, the organization of science and the international relations of science. A committee has also been appointed to report on the world sources of raw materials.

The Department of Agriculture awarded an $842,000 contract on May 25 for construction of an eastern regional research laboratory at Wyndmoor, Pa. The contract calls for completion in four hundred days of the entire administration unit, together with nine sections of the chemical laboratory wing, and the entire service building and power plant.

The cornerstone of Fuld Hall of the Institute for Advanced Study at Princeton was laid on May 22 by Miss Lavinia Bamberger, sister of Louis Bamberger, co-founder of the institute. The building is being erected at a cost of $500,000, on a 400-acre tract of land on the southwest outskirts of the Borough of Princeton. The hall is expected to be completed in time for the opening of the fall term. Fuld Hall, named in honor of the late Felix Fuld, is being constructed of red brick in colonial design. When completed it will contain separate studies for each faculty member and student of the institute's three units, besides administration quarters, seminar rooms, lounges and a library.

DISCUSSION

BIRTH PAINS OF THE ASSOCIATION

One hundred years ago, in 1839, *The Family Magazine, or Monthly Abstract of General Knowledge* published the following article on the organization of a national scientific society. This magazine was published at Boston by J. S. Redfield, first president of the American Association for the Advancement of Science.

I am indebted to Mr. Joseph A. Sadony, Valley of the Pines, Montague, Mich., for the reference and the following quotation. Such words from leaders among our predecessors of a century ago emphasize the enormous changes that have taken place within three generations.

F. R. Moulton,
Permanent Secretary

NATIONAL SCIENTIFICK ASSOCIATION

When the proposition was made, in February last, to the Massachusetts Medical Society, to open a correspondence with other similar bodies, upon the expediency of organising a national association for the advancement of the physical sciences, there were gentlemen who expressed an opinion that the movement was premature; and further, it was maintained that no very marked discoveries or brilliant achievements had resulted from such combinations of the learned in other countries. On the other hand, all important and really striking and meritorious advances in science, literature and the arts, were made, it was contended, in the quiet of the closet, by those who hardly identified themselves with the busy world. In fine, nothing of importance to the promotion of science had emanated from these modern much-talked-of-compacts of the old world.

With a variety of theories and individual presentiments, none of which, by others, were considered of much consequence, it is sufficient to say that the project was rather coldly received, and ultimately quashed in embryo by the committee to whom the matter was referred by consideration. Now it is morally certain that by a little exertion, a successful plan of operation might, by this time, have been devised, and a vigorous co-operation manifested in every state in the union.

The idea that we were too young, as a people, for such a vast undertaking, was preposterous in the extreme. Whoever reflects upon the character of the present age, the spirit that animates all ranks of inhabitants, the impulse given the nation by transatlantick influences, in all departments of life, can not resist the conviction that the same system of perseverance which distinguishes the efforts of civilized man in Europe, will and must be felt in America. With a vast territory, the resources of which are almost incalculable, a consolidation of interests in science, of all the available forces, from the college to the cottage, can alone develop the geological and physical constitution, capabilities and concealed wonders, of this great portion of the habitable globe.

As predicted, another effort is making to rally the learned of the United States around one common centre, to unite in an enterprise which must gratify every friend of science; and of its final success, there is scarcely a remaining doubt, notwithstanding the objections which have heretofore been urged against a scheme so praiseworthy and meritorious. A meeting was held at the hall of the American Academy in this city, a short time since, at which Governour Everett presided, to discuss the propriety of the measure, and a committee was appointed to consult with the Philosophical Society of Philadelphia; and thus the lines are laid, which we fervently hope will speedily eventuate in the establishment of a national association for the promotion of the physical sciences—founded in motives as noble and acceptable to the world as were those which originated the association now existing in England, the organization of which constitutes a new era in the history of that nation. It is to be deplored that our Medical Society did not secure to itself, when the opportunity presented, the honour of having carried into effect this excellent proposition, which might have been done with most perfect ease, and consistently, too, with its character of a scientifick body. For it is evident that practical and enlightened physicians, in all countries, are among the most zealous cultivators of learning and science; and we noticed, upon the occasion alluded to, that of the twenty-seven individuals present, thirteen were members of the Massachusetts Medical Society.

PRELIMINARY ANNOUNCEMENT OF THE GOOSE LAKE, CALIFORNIA, METEORITE

THROUGH the cooperation of several of the officers and the fellows of the Society for Research on Meteorites, namely, Dr. and Mrs. H. H. Nininger, of the Colorado Museum of Natural History and the American Meteorite Laboratory, Denver, Professor Earle G. Linsley, of the Chabot Observatory and Mills College, Oakland, Calif., Dr. Robert W. Webb, of the Department of Geology of the University of California, Los Angeles, and the writer, the largest meteorite discovered up to date in the state of California and probably the fifth largest known to have fallen in the United States, has recently been identified and has just been recovered. The meteorite, which is an iron or siderite, was found on October 13, 1938, by Messrs. Joseph Secco, Clarence A. Schmidt and Ira Iverson, of Oakland, Calif., while hunting deer at a place in northern Modoc County, about two miles west of the western shore of Goose Lake and 1¼ miles south of the California-Oregon state line (coordinates approximately, longitude W. 120° 32′ .5, latitude N. 41° 58′ .6). The meteorite was removed from the place of fall on May 3 and 4, 1939, by a party of which the aforementioned scientists were members. Since the specimen was located in the Modoc National Forest, it is the property of the Smithsonian Institution and the United States National Museum; however, through the kindness of Dr. Alexander Wetmore, the assistant secretary of the Smithsonian Institution, the body will be on exhibition at the Golden Gate International Exposition in San Francisco until the conclusion of the fair.

The over-all dimensions of the meteorite, which is a very irregular mass, deeply pitted, perforated and unoriented, and which resembles in shape nothing more than a gigantic molar tooth, are 3 feet 10 inches × 2 feet 4½ inches × 1 foot 8 inches. The measured weight is 2,573 pounds. Etching the polished surface of a small fragment with dilute nitric acid revealed the characteristic Widmanstätten figures, which indicate that the specimen is a medium octahedrite. The more weathered parts of the meteorite are maroon, while the portions which have lain near or in contact with the soil are cinnamon-brown or rusty. Because all the original fusion crust is missing, we conclude that the fall occurred probably many years ago. The meteorite lay in the center of an almost circular, saucer-like depression or "crater," about five feet in diameter and one foot deep. This formation was the only visible evidence, if evidence it was, of the impact of the body with the ground. As no postoffice is situated within a radius of several miles of the spot where the meteorite was discovered, and it was not near any well-known geographical feature other than Goose Lake, it shall be called the Goose Lake, Modoc County, Calif., meteorite.

FREDERICK C. LEONARD

UNIVERSITY OF CALIFORNIA,
LOS ANGELES

A PARASITE OF THE PUERTO RICAN MOLE-CRICKET

To the record of successful establishments in Puerto Rico of predators attacking insect pests, such as that of the giant Surinam toad, *Bufo marinus* L., largely feeding on native species of May beetles, and of Australian lady-beetles, *Cryptolaemus montrouzieri* Mulsant attacking exposed mealybugs, and *Rodolia* (*Vedalia*) *cardinalis* Mulsant attacking cottony cushion scale, may now be added that of a large wasp, *Larra americana* Saussure, a specific parasite of the changa, (or Puerto Rican mole-cricket, *Scapteriscus vicinus* Scudder).

The changa is not native to Puerto Rico, but occurs throughout most of tropical South America, and is presumably so destructively abundant in Puerto Rico, attacking tobacco, vegetable crops and even sugar-cane in sandy soils, because of the absence here of its natural enemies. Its parasite, *Larra americana*, occurs most conveniently for collection and shipment by airplane at Belem, Pará, Brazil. A successful method of shipping the live wasps, by including with them a screened cage of live parasitized mole-crickets, has been briefly reported,[1] as well as a more extended account of the entire project up to February, 1938.[2] Whether including live parasitized changas with each sending of the wasps is really the reason why the latter remain alive in captivity was not determined by later experiments, but out of 420 wasps sent thus from Belem in May and

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[1] SCIENCE, 87: 355, 1938.

[2] *Jour. Agr. Univ. Puerto Rico*, 22: 193–218, 1938.

June of 1938, 373 arrived alive in Puerto Rico. Some of these wasps were released immediately, but others were used for oviposition on mole-crickets collected in Puerto Rico, and these, together with the parasitized changas which had accompanied the wasps, were released in Puerto Rico to the number of 550. Releases were made in a sandy region near Rio Piedras, and in a similar region near Isabela, in both of which places changas were abundant, and also the plants which the wasps frequent to obtain nectar.

At the end of the rainy season in Puerto Rico, in mid-January, 1939, *Larra* wasps were seen in considerable abundance both at Rio Piedras and at Isabela. These wasps could not possibly be any of those originally released, for the life of the insect is measured by weeks; thus they represent descendants of those released in May and June. Their presence indicates that *Larra* has successfully lived through the coldest and wettest as well as the hottest weather normally experienced in Puerto Rico, and may be considered as established at two localities here. How soon *Larra* will begin to spread to other parts of the island, where conditions are possibly somewhat less favorable, and how soon it will result in a marked decrease in changa injury, can not now be predicted, but at least its establishment in two widely separated regions marks one more step in the solution of the problem of control of the changa by natural means.

GEORGE N. WOLCOTT

AGRICULTURAL EXPERIMENT STATION,
UNIVERSITY OF PUERTO RICO,
RIO PIEDRAS

OVUM CULTURE

IN certain press reports of a recent paper on meiosis in explanted human ovarian ova the statement has appeared that I plan to carry on this work to the extent of attempting to discover if human offspring can be produced by the methods we employ in ovum culture. This statement is incorrect. My work with human ova ended with these studies of maturation, and I have no intention whatsoever of continuing them.

GREGORY PINCUS

CLARK UNIVERSITY

LECTURERS IN GEOLOGY AND GEOGRAPHY

AT the recent annual meeting of the Division of Geology and Geography of the National Research Council the suggestion was made that university departments in various parts of the country may be interested in knowing when distinguished foreign geologists and geographers are available for special lectures. The division chairman was requested to organize a sort of information bureau for this purpose. Every year some scientists in these fields visit this country. At the present time a number of such scientists are here as refugees from foreign countries.

After some exchange of information on the subject it may be possible to arrange lecture tours, planned cooperatively by neighboring universities and colleges in such a way as to reduce to a minimum the cost involved for each institution. As a first step in organizing the required information, those who know of men suitable and available for such lectures are requested to send to the undersigned the names and addresses of the men, together with pertinent data regarding their careers and publications. When sufficient information has been brought together, a means for its publication will be found.

The ability of each prospective lecturer to speak clear English is of course an important requisite. It is requested that this point be given particular attention in all information that is furnished.

The present college year is near its close. However, information furnished during the summer may make possible the institution of the plan early next fall.

CHESTER R. LONGWELL,
Chairman, Division of Geology and Geography,
National Research Council,
2101 Constitution Ave., Washington, D. C.

SOCIETIES AND MEETINGS

SIGMA PI SIGMA CONVENTION

THE fourth national convention of Sigma Pi Sigma, physics honor society, was held from April 6 to 8 at the Ohio State University. One hundred and thirty-two guests and delegates from twenty-eight chapters were registered. The convention program included inspection tours of research activities at the university and the Perkins Astronomical Observatory, scientific addresses and demonstration lectures, business sessions and social events. The presidential address by Dr. R. C. Colwell, of West Virginia University, on "Electromagnetic Waves and Radio Signals" described his own and other researches on ionizing layers in the atmosphere. Mr. Royal Weller, of the Ohio State University, presented a demonstration lecture of novel experiments in general physics. At the banquet the speakers were Dr. Alpheus W. Smith, head of the physics department at Ohio State, Dr. W. H. Bennett, director of research at the Electronic Research Corporation, Newark, Ohio, and Dr. H. W. Russell, director of the Battelle Memorial Institute, Columbus, Ohio. The main convention open meeting was addressed by Dr. Paul E. Klopsteg, president of the Central Scientific Company, following his reception into the society as an honorary member. His address on "Archery: A Physicists' Hobby" was illustrated by lantern slides and an extensive exhibit of bows and arrows of both modern and ancient design. Dr. Klopsteg described the researches which he and others have made upon the scientific investigation of the physics of archery, which led to an explanation of the "paradox of archery" and the design of bows of incomparably better performance than those formerly used.

A panel discussion on the topic "How Shall the Physicist Get a Job?" was conducted by Dr. M. N. States, with Dr. W. P. Davey, of the Pennsylvania State College, and Dr. William E. Forsythe, of the Nela Park Research Laboratories, as principal speakers. At the Perkins Observatory of the Ohio State and Ohio Wesleyan Universities, the director, Dr. N. T. Bobrovnikoff, gave an illustrated address on "Astrophysics, a Borderland Science."

The convention authorized the expansion of the services of the placement board of the society and its establishment upon a permanent basis. This board will serve as an agency to bring to the attention of prospective employers of physicists the availability of certain members of the society and will function as a general clearing house for information regarding the placement of graduates in physics.

The report of the executive secretary to the convention indicated that the society has a total membership of 2,435 and an active chapter membership of 650. There are thirty-two active chapters. The convention authorized the establishment of a classification of "sustaining membership" among the alumni members of the society. The contributions of these members are to be kept in a separate fund and administered by a fellowship board to assist graduate-student members of the society to pursue further graduate work and research.

The executive secretary also reported that the society had just installed its thirty-second active chapter on April 4 at the Fort Hays Kansas State College, Hays, Kansas. The installing officers were Dr. Malcolm C. Hylan, of the University of Colorado, and Dr. R. A. Rogers, of Park College. At a general college assembly preceding the installation, Dr. Hylan gave an illustrated address on "A Dream Come True," in which he discussed some of the contemporary developments in the field of induced radioactivity. The charter group included thirty-one students and alumni. Dr. Harvey A. Zinszer is the head of the department of physics at Hays.

Officers elected at the close of the convention were: *President,* Dr. F. C. Blake, Ohio State University; *Vice-president,* Dr. Joyce C. Stearns, University of Denver; *Executive Secretary,* Dr. Marsh W. White, the Pennsylvania State College. Members of the Executive Council elected were: Dr. R. C. Colwell, West Virginia University; Dr. D. W. Cornelius, University of Chattanooga; Dr. W. P. Davey, Pennsylvania State College, and Dr. R. I. Allen, John B. Stetson University.

MARSH W. WHITE,
Executive Secretary

THE KANSAS ACADEMY OF SCIENCE

THE seventy-first annual meeting of the Kansas Academy of Science was held at the University of Kansas, on March 30, 31 and April 1, 1939, under the leadership of Dr. Walter H. Schoewe as president. The opening lecture was given by Dr. Charles A. Shull, of the University of Chicago, who spoke on Thursday evening on the subject, "The Plant in Relationship to the Water System of Its Environment." This lecture was sponsored by the Kansas chapters of Phi Sigma, Sigma Xi and the Kansas Academy of Science.

Sectional programs opened on Friday morning and continued until 11 o'clock, when the first general business session was held. An interesting innovation in the program of the first business session was one-minute reports of the recipients of the 1938 research awards. These were followed by reports of officers, delegates to meetings and a lantern slide demonstration lecture on color photography by Oren Bingham. The slides were truly remarkable in their beauty, range of subjects and color values.

The second business and general session was held on Saturday at 8 A.M. President Schoewe gave the annual presidential address on the subject, "The Conservation of our Natural Areas." This is a subject in which Dr. Schoewe is greatly interested and is unusually well fitted to discuss. He stressed the difficulties which have arisen to making areas into national parks or national monuments and maintaining them as such.

Mrs. Otilla Reagan, who so graciously established the Albert B. Reagan Endowment in the Academy in memory of her distinguished husband, attended the academy sessions and spoke following the business meeting on "Reminiscences of our Indian Service." She recounted many interesting experiences and observations during their long period of work on Indian Reservations.

The Committee on Research Awards made the following grants for 1939–1940: To F. L. Carter, of Wilson, Kansas, award no. 3 of $32.50 from the Albert B. Reagan Memorial, for "A Study of the History of the Changes in the Mammal Population in Western Kansas"; to Claude W. Hibbard, of the University of Kansas, $25.00 for "Completion of a Study of the Upper Pliocene Fauna of Kansas, and Relation to the Blanco Fauna of Texas"; to Andrew Riegel, graduate student of Fort Hays Kansas State College, $25.00 for "A Study of the Variations in Growth of Blue Grama Grass"; to Charles Wolfson, graduate student at the University of Kansas, $32.50 for "Investigations of Existence and Origin of Electrical Potential Differences in Single Cells"; and to A. P. Friesen, of Bethel College, Newton, Kansas, $35.00 for his study of the "Determination of Optical Properties of Liquid Metals and Alloys." The total awarded was $150.00, consisting of $75.00 from the American Association for the Advancement of Science, $42.50 from the academy treasury and $32.50 from the Reagan endowment.

The Kansas Weather-crops Seminar, Dr. J. H. Parker, president, and Dr. H. H. Laude, secretary, affiliated with the academy.

A series of lantern slides on the monument rock area in Gove County, Kansas, were shown as a part of the report of the committee on natural areas. George M. Robertson reported on the geology, F. W. Albertson on the flora, and L. D. Wooster reported on the fauna of this area, which it is hoped to have designated some day as a state park.

The reports of the sections are presented in Table 1.

TABLE 1

Name of section	Chairman, 1939	Attendance	Number of papers	Chairman for 1940
1. Botany	C. C. McDonald	75	33	M. W. Mayberry
2. Chemistry ...	F. T. Owen	60	12	Harold P. Brown
3. Geology	D. C. Schaffner	50	19	A. C. Carpenter
4. Medical Science	Parke Woodard	60	12	none
5. Physics	P. S. Albright	80	15	A. B Cardwell
6. Psychology ..	Jos W. Nagge	63	15	W. H Mikesell
7. Biology Teachers	Gladys Beck	40	7	John Breukelman
8. Zoology	E. H Herrick	60	37	A. B Leonard
9. Kans. Entomological Society	L. C. Woodruff	55	28	R. T. Cotton
10. Junior Academy of Science	Bob Akey, President Dorothy Brownlee, Secretary	250	12	Gabe Sellers, Jr., President Kenneth Hunt, Secretary

The Junior Academy Committee, consisting of Miss Edith Beach, chairman, J. R. Wells and J. A. Brownlee, had an unusually successful year. Twenty-nine Junior Academy groups are now affiliated with the academy, of which 12 are new members and were specially inducted into the association with appropriate ceremony. Eleven clubs participated in the program. The Manhattan High School group was awarded first place because of their demonstrations and exhibit and were given possession of the Junior Academy cup for the year. Lawrence Junior High School was awarded second place. Jane Miller, of Lawrence, and Bob Hull, of Wichita, were awarded the honorary Junior memberships in the American Association for the Advancement of Science for the year.

The Kansas and Nebraska chapters of the American Association of University Professors again met in cooperation with the academy, under the chairmanship of Dr. D. A. Worcester. The attendance was 65, and there were four main addresses given. Professor Robert Conover was elected chairman for 1940.

On Friday evening, the regular banquet was held, with Dr. H. H. Hall, president-elect, as toastmaster. Chancellor E. H. Lindley gave an appropriate short address of welcome, emphasizing that science and scientists are less presumptuous now than formerly and that they now have their logical, but important, place in institutions of higher learning along with arts, literature and the humanities. Following the banquet occurred the unusually instructive and interesting illustrated lecture by Dr. Laurence McKinley Gould on "Explorations in the Antarctic."

The newly elected officers for 1939–1940 are: *President,* Dr. H. H. Hall, Kansas State Teachers College, Pittsburg; *President-Elect,* Dean E. O. Deere, Bethany College, Lindsborg; *Vice-President,* Dr. F. C. Gates, Kansas State College, Manhattan; *Secretary,* Dr. Roger C. Smith, Kansas State College; *Treasurer,* Dr. H. A. Zinszer, Ft. Hays Kansas State College, Hays; *Executive Council*—Dr. W. H. Schoewe, the retiring president, Lawrence; Dr. L. D. Bushnell, Kansas State College, Manhattan, and Dr. R. H. Wheeler, University of Kansas, Lawrence. *Associate Editors:* Dr. R. E. Mohler, McPherson College, and Dr. A. B. Cardwell, Kansas State College, Manhattan, both serving until 1942.

Three hundred and thirty-five persons registered for the meeting, which is the largest registration ever recorded for an annual meeting. One hundred twenty-five new members joined the academy during the year. The present membership totals 686. The academy lost 10 members by death during the year.

The following chairmen of committees were appointed by President-Elect Hall for 1939–40: The Committee on Conservation and Ecology, W. H. Schoewe; Research, L. D. Wooster; Coordination of Science Groups, W. J. Baumgartner; Handbooks, R. J. Barnett; Membership, Roger C. Smith; Necrology, Roy Rankin; New Sections, F. C. Gates; Junior Academy, J. A. Brownlee; Editorial Trends, J. A. Glaze; Science Teaching, J. A. Trent; Coordinating Finance, H. A. Zinszer; Publication Fund, F. W. Albertson; Endowments and Investments, H. A. Zinszer; State Aid, W. J. Baumgartner, and Nominating, W. H. Matthews.

The academy will meet at Wichita in 1940, and at Manhattan in 1941.

ROGER C. SMITH,
Secretary

KANSAS STATE COLLEGE,
MANHATTAN

SPECIAL ARTICLES

A COMPARISON OF WATER CULTURE AND SOIL AS MEDIA FOR CROP PRODUCTION

IN recent years, great interest has been aroused in the possibilities of using a water-culture medium, as an alternative to soil, for purposes of crop production. The idea of making commercial use of the water-culture method, heretofore employed for over three quarters of a century solely for scientific studies, was conceived some time ago by W. F. Gericke, who devised a special technique for growing plants in large tanks filled with nutrient solution.[1, 2]

This development was soon given great publicity in the popular press and stimulated wide discussion of the possible social and economic implications of certain proposals for dispensing with the soil as a medium for growing many crops. Such discussion has frequently been based on the following claims: (1) The inherent productive capacity of a given surface of nutrient solution far surpasses that of an equivalent surface of even very fertile soil; either because individual plant yields are higher or because plants can be grown more closely spaced in nutrient solutions than in soil; (2) heating the nutrient solution results in large increases in yields of crops; (3) plants can be grown in nutrient solutions with greater water economy than in soil; (4) food produced by the water-culture method has a higher dietetic value (minerals and vitamins) than that produced in soil; (5) plants grown in nutrient solutions are, in contrast with those grown in soil, free from attack of insects and diseases.

At the suggestion of the director of the California Agricultural Experiment Station, we have undertaken to gain information which would bear directly on the claims listed above, by comparing, under controlled greenhouse conditions, a fertile soil with a favorable nutrient solution, as media for crop production. A full discussion of the results will be published elsewhere, but it is desired to present at this time some of the results and conclusions which may be of general interest.

Since much of the current discussion of the water-culture method is based on work with the tomato, it was adopted as a test plant for this investigation. Tomato plants were grown in a Berkeley greenhouse, in soil and nutrient solution, side by side, with the same spacing and cultural treatment for plants grown in the two media. This arrangement was considered essential to any attempt to compare yields attainable by the two methods. In most popular discussions of the subject, yields of fruit harvested on a small unit of surface, from tomato plants grown in the protection of a greenhouse, for a twelve-months period, have been compared with average field yields under all types of soil and climatic conditions, computed on the basis of large acreages. Such comparisons may be very misleading.

The soil beds occupied the same surface as the tanks of nutrient solution (25 square feet) and consisted of an open-bottom box filled with soil to the depth of two feet. The soil, secured from a commercial greenhouse, had been used successfully in the production of tomatoes. It was autoclaved for 6 to 7 hours prior to use and fertilized with manure, potassium and phosphorus, with the addition of gypsum, in a manner corresponding to the usual fertilization treatment given to that soil under commercial conditions. The nutrient solution, including microelements (solutions A4 and B7), used in the water-culture tanks, has been previously described.[3]

The spacing of plants, the porous bed used in all water-culture tanks, and the heating arrangement used in some soil and water cultures were similar to those described by Gericke and Tavernetti.[2]

Two crops were grown in the course of one calendar year: A fall-winter crop from August to January and a spring-summer crop fom February to August. In the latter period, an aerated unheated nutrient solution and a heated bed of pure sand, 2 feet deep, irrigated daily with nutrient solution, were included in the experiment. The temperature in the heated cultures was maintained around 70° F. in the fall-winter period, and around 75° F. in the spring-summer period. The temperature in the unheated soil and solution varied from 57° to 68° F., depending on the air temperatures.

All plants were staked and trained to single stems, and were allowed to extend to the full height of the greenhouse. Records of individual plant yields were kept only during the spring-summer period (Table II). Since fruit was borne over the entire length of vines, the highest yields were obtained from the tallest

TABLE I

YIELD OF TOMATO* PLANTS GROWN FOR A SIX MONTHS' PERIOD FROM AUGUST TO JANUARY IN SOIL AND NUTRIENT SOLUTION

(20 plants to 25 square feet of surface)

Treatment	Average yield per plant in pounds
Soil heated	6.0
Solution heated	5.7
Soil unheated	6.7
Solution unheated	5.5

* Variety Crackerjack (Earliana).

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[1] W. F. Gericke, *Am. Jour. Bot.*, 16: 862, 1929.

[2] W. F. Gericke and J. R. Tavernetti, *Agr. Engineering*, 17: 141–143, 1936.

[3] D. I. Arnon, *Am. Jour. Bot.*, 25: 322–325, 1938.

plants and lower yields from those which could extend only to the lower portion of the sloping greenhouse roof. The highest yields of individual plants from soil and water-culture are given in Table II to indicate the potentialities for fruit production of both media, with relatively unrestricted vertical extension of vines.

TABLE II

YIELD OF TOMATO PLANTS* GROWN FOR A SIX MONTHS' PERIOD FROM FEBRUARY TO AUGUST IN SOIL, SAND AND NUTRIENT SOLUTION

(20 plants to 25 square feet of surface)

Treatment	Average yield per plant in pounds	Highest yield of individual plant in pounds
Soil heated	14.2	28.1
Solution heated	17.0	24.1
Soil unheated	13.9	24.1
Solution unheated	15.7	20.2
Solution unheated, aerated	21.1	28.0
Sand heated	21.6	32.4

* Variety Lloyd Forcing. We are indebted to Dr. W. A. Huelsen, of the Illinois Agricultural Experiment Station, for furnishing the seed.

The yields, on the basis of comparable season and time period, obtained in our experiments with the water-culture method previously described[2,4] were higher than any heretofore reported,[2,4] but considering the variability of cultures, these yields can not be regarded as markedly different from those obtained in soil.[5] The average yields, as well as the highest yields of individual plants, from soil and water cultures do not justify a conclusion that the potential crop yield is higher in a favorable nutrient solution than in a fertile soil. Nor was any evidence found in support of the contention that higher yields per unit of surface can be expected from the water-culture technique as a result of closer spacing of plants than is possible in soil. As already pointed out, the same dense spacing was maintained in the soil beds and in the water-culture tanks and yet no difficulty was experienced in either medium in supplying enough water and nutrients to the plants. The indications were that even under the favorable light conditions prevalent at Berkeley, California, the light factor would determine the most profitable spacing of plants in either soil or nutrient solution, assuming a favorable root environment in both.

Heating the nutrient solution produced no great effect at the two periods of the year on the yield of fruit (Tables I and II). The greenhouse was not heated except on a few occasions to prevent temperatures from falling below 50–55° F. The average Berkeley greenhouse air temperatures during most of the year were sufficiently high to maintain in the unheated cultures a nutrient solution temperature around 65° F., which was adequate for growth. It appears, therefore, that if air temperatures are favorable, the solution temperature will take care of itself.

A marked increase of yield of fruit from unheated nutrient solution resulted from continuous forced aeration. The beneficial effect of improved aeration was also reflected in the growth and yield of plants in sand culture (Table II). There is no reason to believe, however, that comparable yields could not be produced in a soil, which would combine the conditions of optimum aeration, associated with light texture (lighter than that of the soil used in this investigation), with a fully adequate supplying power for nutrients and water. These results suggest, incidentally, that under many climatic conditions aeration of solutions may hold greater promise of increasing yields in commercial water-culture practice than heating the solution.

In the spring-summer experiment records were kept of the amounts of water supplied to the soil and solution cultures. The level of nutrient solution in the tanks was maintained within several inches from the top of the tank, while the usual commercial practice was followed in watering the soil. The experimental data (Table III) indicate that more water was required to produce a unit weight of fruit under water-culture conditions than under soil conditions, although the significance of the difference in water consumption can not be evaluated on the basis of evidence now available.

TABLE III

UTILIZATION OF WATER IN THE PRODUCTION OF TOMATO FRUIT IN SOIL AND NUTRIENT SOLUTIONS

Treatment	Gallons of water used to produce 100 pounds of fruit
Soil heated	214
Solution heated	276
Soil unheated	222
Solution unheated	257

As a part of this investigation, studies of chemical composition and general quality have been made on tomatoes of several varieties grown in the greenhouse in fertile soil, sand and water culture media under the same climatic conditions. No significant difference has been found in the calcium, phosphorus, magnesium, potassium, nitrogen and sulfur content of fruit developed on plants grown in the several media. Neither could any significant difference be found in content of carotene (provitamin A), and vitamin C. Tomatoes harvested from the soil and water-culture could not be consistently distinguished in a test of flavor and general quality.[6]

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[4] W. F. Gericke, *Nature*, 141: 536–540, 1938.

[5] Recently data have also become available on yield of potatoes grown in a bed of peat soil in Berkeley. This yield was as large as any heretofore reported as obtained by the water-culture method.

[6] The quality tests were conducted by Dr. Margaret Lee Maxwell, of the Division of Home Economics, and the carotene determinations were made by Dr. Gordon Mackinney, of the Division of Fruit Products, College of Agriculture.

Contrary to some statements, plants grown by the water culture method are not protected against diseases or insects attacking the aerial parts of plants. While the risk of strictly soil-borne disease can be ruled out, recent observations suggest that diseases peculiar to water culture may sometimes attack plants grown in nutrient solutions.

The results of our experiments confirm earlier views that the possibility exists of producing crops on a large scale by the water-culture method. The fact that yields and general quality of plant products are at least equal to those produced under extremely favorable soil conditions (admittedly not generally found) is considered of great interest, but no support was found for the assumption that the potentialities for crop production of a favorable nutrient solution medium far exceed those of a very fertile soil.

A sober appraisal of the commercial possibilities of the water-culture method should be based not on the expectation of fabulous yields, far in excess of any obtainable in soil, or unusual dietary qualities of plant products, but rather on the knowledge that under competent supervision very good crops could be produced in localities favored in climate and water supply, but where good soil is not available or when it is found too expensive to maintain highly favorable soil conditions. Also a water-culture medium when expertly supervised should be subject to more exact control than a soil medium. Other investigators have developed large-scale techniques for growing crops in inert solid media, such as sand and gravel.[7, 8]

It must be clearly recognized that the application of the water-culture method for crop production will be limited primarily by economic considerations. What crops could be grown profitably by this method would depend on the value of the crop in the market served in relation to cost of production, which would include a large outlay for tanks and other equipment and materials, as well as special costs of supervision and operation. An important distinction must be made between field and greenhouse operations. It seems highly improbable, in view of the present cost of a commercial water-culture installation and its operation, that crops grown by this method could compete with cheap field-grown crops.[9] In greenhouses specializing in high-priced, out-of-season crops the method appears to have commercial possibilities. The expense of growing greenhouse crops in soil, including cost of equipment for sterilizing soils, may frequently stand comparison with the cost of growing crops by the water-culture method.

However, before any one undertakes to grow plants by the water-culture method, even in greenhouses, he should give the most careful consideration to the economic factors involved and to the need for expert guidance, in the absence of which commercial success is unlikely. The practical experience which many growers have acquired in growing plants in soil may prove of little avail in solving some unfamiliar problems of water-culture technique. It is suggested that those who contemplate installation of the water-culture method for commercial purposes make a preliminary test with a few tanks, to learn some of the requirements of the process.

The suggestion that important amounts of food could be produced economically in small-scale installations for home use has no sound basis, because of high costs of the installations and technical requirements for the successful use of the method.

The continued importance of the use of water-culture technique, as one important method of scientific experimentation in investigations of problems of plant nutrition, needs to be stressed. The development of large-scale water-culture techniques enhances the usefulness of the water-culture method as an experimental tool, by widening its scope of application to problems which involve growing plants to maturity on a large scale and under controlled conditions of nutrition.

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THE CHORIO-ALLANTOIC MEMBRANE OF THE DEVELOPING CHICK AS A MEDIUM FOR THE CULTIVATION AND HISTOPATHOLOGIC STUDY OF PATHOGENIC FUNGI

ALTHOUGH the chorio-allantoic membrane of the developing chick has been used by numerous investigators as a medium for the cultivation and study of many bacteria, viruses, Rickettsiae and recently of a spirochete,[1] it has not been used extensively (as far as could be determined) for the study of fungi. Goodpasture[2] mentioned these micro-organisms in his Leo Loeb Lecture at the Washington University School of Medicine, on March 24, 1938, and in personal correspondence stated, "we have never made any consistent investigation of fungus infection in this host" (embryo chick). The purpose of this paper is to report briefly

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[7] H. M. Biekart and C. H. Connors, *New Jersey Agr. Exp. Sta. Bul.* 588, 1935.

[8] R. B. Withrow and J. P. Biebel, *Purdue Agr. Exp. Sta. Cir.* 232, 1937.

[9] Recently, popular journals have discussed a project for growing vegetables in tanks of nutrient solution, on Wake Island, in Mid-Pacific, to supply fresh vegetables (which constitute only a small proportion of the total food requirements) for the inhabitants of the island and for passengers of the Clipper airships. This, however, is a special case, and there is no reason to assume that it has any general agricultural significance.

[1] G. Morrow, J. T. Syverton, W. W. Stiles and G. P. Berry, SCIENCE, 88: 384, 1938.

[2] E. W. Goodpasture, *Am. Jour. Hyg.*, 28: 111, 1938.

the results of the successful inoculation of the chorio-allantois with fungi.

During the year of March, 1938, to 1939, work was started at Barnard Hospital to determine the possible virus etiology of a number of skin diseases, the causes of which are obscure. We have been equipped with the apparatus to carry on the technique of chick egg inoculation as practised in Goodpasture's laboratory and as elaborated by Goodpasture and Buddingh.[3] Dr. Floyd S. Markham, who has been carrying on the virus work, assisted in the inoculation of the chick membranes with fungi.

A wide variety of pathogenic fungi have been used, representing the causative agents of diseases which affect: (1) the superficial layer of the skin; (2) mucous membranes; (3) dermis and subcutaneous layers; (4) internal viscera. These organisms are known to produce pityriasis, superficial desquamations, localized granulomata, deep-seated ulcerative lesions, mucous membrane plaques; lymph stream invasion with dermic and subsequent epidermic involvement and visceral or generalized diseases. These microbes produce the following diseases: seborrheic dermatitis, tinea versicolor, endomycosis, geotrichosis, moniliasis, blastomycosis, coccidioidal granuloma, sporotrichosis, maduromycosis, trichophytosis, epidermophytosis, microsporosis, favus, cryptococcosis, paracoccidioidal granuloma, chromomycosis and actinomycosis.

The fertilized eggs used were 12 to 14 days old. Inoculations from cultures of the fungi were made directly on the chorio-allantoic membrane. The embryo lived from 4 to 11 days after inoculation, depending on the type of organism used. Macroscopically the diseases manifested themselves as thickened or thin, white, grayish or grayish-brown, confluent or discrete plaques on the membrane, depending again on the variety of fungus.

The infected membranes were fixed in Zenker's, embedded in paraffin, sectioned and studied. Histopathologically, the reaction of the tissue manifested itself in the form of nodules, ulcers, superficial growths and hyperplastic lesions, which were comparable in most instances to those seen in human infections. Further microscopic examination showed an increased activity in the membranes, as was evidenced by the intense infiltration, particularly with the invasive type of organism, of ectodermal cells, blood cells, fibroblasts, monocytes, accompanied in most cases by inflammatory changes in the mesoderm and marked edema at the sites of fungus growth. The thickening of the membrane in some cases was due to the cellular infiltrate, in others where the organism is known to produce granulomatous lesions, to the mat of mycelial elements of the fungus, but in most cases to the combination of both. Those membranes parasitized by *Monilia albicans,* in addition to the marked proliferation and hypertrophy of the ectoderm, showed, in the mesoderm, pearls of growth which correspond in human tissue to an increased hyperkeratinization. A degree of tissue specificity was also demonstrated in that fungi affecting mucous membranes and the superficial layer of the skin particularly involved the ectoderm, whereas those found affecting the dermis, subcutaneous layers and internal viscera seemed to affect in addition the entoderm and mesoderm. Intra-amniotic, intra-cerebral and body injections will be carried on to determine absolute specificity of tissues in the chick embryo to the various fungi.

The fungi stain very easily in section with methylene blue and eosine. In most cases the organisms revert to the forms seen in human lesions—their parasitic role. This reversion in morphology is complete with the yeast-like organisms in approximately 6 days, whereas with some filamentous forms it begins on the fifth day and is complete on the tenth or eleventh day.

In summary, it can be said, therefore, that the chorio-allantoic membrane of the developing chick can be successfully inoculated with pathogenic fungi. The organisms produce fatal mycoses with most microbes which in tissue response simulate closely human lesions, showing a degree of specificity as found in infection in man. This method, as contrasted with the use of standard laboratory animals, is much less expensive and, more significant than that, reduces the time elements from weeks or months to days. The inability to find suitable experimental animals or human volunteers enhances the value of the use of the chorio-allantois for fungous inoculations.

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THE TRANSMISSION OF LYMPHOCYTIC CHORIOMENINGITIS BY MOSQUITOES

ONE year ago a highly virulent spontaneous infection occurred among rhesus monkeys that were being used in this laboratory for the study of experimental malaria. The severity of the infection was such that eleven monkeys died in a week. The infection was characterized by dependent edema, serosanguineous nasal discharge, marked prostration and extremely rapid course. At death the outstanding gross abnormalities were partial consolidation of the lungs and an abundant collection of straw-colored fluid in the serous cavities. The causative agent of the epizootic was identified by Dr. Thomas Francis, Jr., as being the virus of lymphocytic choriomeningitis. Under normal conditions the mode of transmission of this disease, either in man or animals, is unknown, but since the virus was found to be present in high concentration in the circulating blood of some experimental animals, the possibility of an insect vector was considered. Experiments completed have demonstrated the ability of *Aedes aegypti* mosquitoes to transmit the disease to guinea pigs by bite.

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[3] E. W. Goodpasture and G. J. Buddingh, *Am. Jour. Hyg.*, 21: 319, 1935.

In the initial experiment a guinea pig was inoculated subcutaneously with 1.0 cc of a 1–10 dilution of frozen and desiccated blood from one of the monkeys which had died 6 months previously. On the seventh day following inoculation, when the guinea pig was obviously ill, a lot of normal *Aedes aegypti* was allowed to feed upon it. Five days later seven of these mosquitoes were first allowed to bite a normal guinea pig, then were ground finely in a mortar with normal saline and injected into another normal guinea pig. The guinea pig which received the injection of killed mosquitoes died on the seventh day, and the one which was bitten by the same insects died on the eighth day. Before death another lot of normal *Aedes aegypti* was allowed to feed upon the latter animal. These mosquitoes also produced a fatal infection when six days later fifteen of the insects were permitted to bite a normal guinea pig, thus establishing two serial consecutive guinea pig-mosquito-guinea pig passages.

Other experiments have shown that the mosquitoes are capable of transmitting the virus as early as the fourth day and at least as late as the fifteenth day after feeding on an infected animal. Death has occurred between the eighth and eighteenth day following the bite of infected mosquitoes, while duplicate guinea pigs which were inoculated with an emulsion of the same mosquitoes usually died twenty-four to forty-eight hours earlier. In one experiment the bite of sixteen mosquitoes caused death on the eleventh day, while the bite of four mosquitoes from the same lot produced no obvious signs of illness. However, the surviving animal was later shown to be immune when inoculated with a large dose of known living virus. The study is being extended to include other hosts and vectors.

The virus of lymphocytic choriomeningitis in guinea pigs dying following the bite of infected mosquitoes was identified by means of a specific immunity test. The virus was neutralized by known immune guinea pig and immune monkey serum. The latter was from a monkey which survived the epizootic mentioned above and was found by Dr. J. E. Smadel, of the Rockefeller Institute, to contain both complement-fixing and neutralizing antibodies against a known strain of lymphocytic choriomeningitis virus.

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INCREASED GLYCURONATE EXCRETION FOLLOWING ADMINISTRATION OF SULFAPYRIDINE[1]

IN the course of the isolation of urinary excretion products of sulfapyridine,[2] a urine concentrate containing a diazotizable substance in concentrations considerably above the solubility of sulfapyridine or its acetyl derivative was obtained. This suggested, among other things, that the drug might be excreted in part as a sulfate or a glycuronate. Concurrent with isolation studies, we have followed the glycuronate[3] excretion in two normal males on a carefully controlled diet after the administration of a single dose of five (5) grams of sulfapyridine. A pneumonia patient was similarly studied. In each case, the glycuronate output was markedly increased during the first twenty-four hours and fell to normal within two to four days. The glycuronate concentrations paralleled the urine levels of sulfapyridine.

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[1] These studies received financial support from New York University (Littauer Pneumonia Research Fund), from the Metropolitan Life Insurance Company, and from the gifts of Mr. Bernard M. Baruch, Mr. Bernard M. Baruch, Jr., Miss Belle N. Baruch and Mrs. H. Robert Samstag.

[2] H. D. Ratish, J. G. M. Bullowa, J. B. Ames and J. V. Scudi, *Jour. Biol. Chem.*, 128: 279, 1939.

[3] G. B. Maughan, K. A. Evelyn and J. S. L. Browne, *ibid.*, 126: 567, 1938.

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AN EVALUATION OF THE FACTORS RESPONSIBLE FOR PUBLIC HEALTH PROGRESS IN THE UNITED STATES[1]

By Dr. MURRAY P. HORWOOD

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One of the striking phenomena of the twentieth century and to some extent also of the last quarter of the nineteenth century has been the curtailment of premature mortality, the prevention of disease and the prolongation of the average life span of man. Since 1880, the general death rate has been diminished more than 50 per cent. and the average expectancy of life at birth has been increased from 40 years to approximately 61 years. Typhoid fever and diarrhea and enteritis have diminished almost to the vanishing point in many communities; cholera and typhus fever are rarely causes of death in this country to-day; the incidence and deaths from diphtheria have been greatly reduced; smallpox is under control in all communities where vaccination is practised; bubonic plague, though endemic in certain restricted areas, is not responsible for many cases of disease or many deaths; the infant death rate has been diminished more than 75 per cent.; the death rate from tuberculosis, at one time the most important single cause of death, has been reduced 75 to 80 per cent.; hookworm is controlled in the South; yellow fever is now non-existent in this country; and malaria is under better control. This remarkable progress in public health occurred during a period of rapid and increasing urbanization and congestion in this country, when conditions should have favored high death rates. Obviously, some factor or factors must have been at work to effect this tremendous saving of human life, and a correct evaluation of these factors should therefore be of great interest and value. Shryock[2] describes the conditions that prevailed prior to the advent of modern public health measures as follows:

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[1] Contribution No. 146 from the Department of Biology and Public Health, Massachusetts Institute of Technology, Cambridge, Mass.

> The tragic history of the major endemic diseases, typhus, typhoid and tuberculosis, is familiar enough. So far as can be judged from the imperfect bills of mortality, urban death rates rose ominously during the first half of the nineteenth century. New York City, which was most inundated by poor immigrants and which grew most rapidly, affords a striking example. In 1810, the crude death rate had been reported as about 21 per 1,000; by 1857, it had risen to around 37 per 1,000—an increase of almost 80 per cent. within 50 years. Rates were lower in Philadelphia, but higher in New Orleans. What an increasing mortality implied in morbidity rates, to say nothing of "subclinical illness," is obvious enough.

And in 1937, the estimated general death rate for the United States, based on 85 per cent. of the total population, was 10.9 per 1,000 population.[3]

The remarkable saving in human life can not be appreciated fully from a mere citation of reductions in death rates and the increase in the average expectancy of life at birth. It is necessary to know the difference between the actual number of deaths occurring to-day and the number of deaths that would have occurred if the old death rates still prevailed. This information is presented in Table 1 for the years 1900 and 1935, both for all causes of death as well as certain principal causes.[4]

It is evident from Table 1 that approximately 768,000 lives are saved annually among the white population of the United States as a result of the curtailment in the death rate since only 1900, an extraordinary achievement based on magnitude alone but one that can hardly be evaluated in terms of the prevention of human misery and suffering and in terms of the maintenance of the unity of families. Among the outstanding achievements noted in the preceding table are the reduction in the deaths from tuberculosis, influenza and pneumonia, diarrhea and enteritis, diphtheria and typhoid and paratyphoid fevers. The saving of life from these diseases alone is equivalent to 61 per cent. of all the lives saved by the reduction in mortality since 1900.

TABLE 1

ACTUAL DEATHS IN THE WHITE POPULATION OF THE UNITED STATES DURING 1935 FROM ALL CAUSES OF DEATH AND FROM SEVERAL PROMINENT CAUSES OF DEATH, COMPARED WITH THE CORRESPONDING NUMBERS EXPECTED IN THAT YEAR ON THE BASIS OF THE MORTALITY RATES BY SEX AND AGE PREVAILING IN 1900*

Cause of death	Deaths in 1935		Lives saved in 1935 by improvement in mortality since 1900	Lives lost in 1935 by retrogression in mortality since 1900
	Actual	Expected on basis of mortality in 1900		
All causes	1,207,359	1,975,761	768,402	
Tuberculosis, all forms	51,269	224,384	173,115	
Influenza and pneumonia†	110,191	232,187	121,996	
Diarrhea and enteritis‡	17,018	125,448	108,430	
Principal communicable diseases of childhood	13,182	72,127	58,945	
Measles	3,435	12,590	9,155	
Scarlet fever	2,646	9,336	6,690	
Whooping cough	3,673	10,715	7,042	
Diphtheria	3,428	39,486	36,058	
Typhoid and paratyphoid fever	2,386	35,652	33,266	
Nephritis	89,240	115,239	25,999	
Cerebral hemorrhage and softening	85,732	102,535	16,803	
Puerperal state	10,018	14,504	4,486	
Organic heart disease	212,167	153,584		58,583
Cancer	129,124	86,103		43,021
Diabetes	26,606	14,301		12,305
External causes (excluding suicides)	94,851	84,688		10,163
All other causes	365,575	715,009	349,434	

* As observed in the original death registration states and the District of Columbia, 1900.
† Excluding capillary bronchitis.
‡ Includes duodenal ulcer.

Contrariwise, there has been no reduction in the mortality from such diseases as organic heart disease, cancer and diabetes or from external causes. Their significance has rather increased as the population has grown older and as the more readily preventable deaths have been brought under control. The ten principal causes of death in the United States to-day,[5] presented in the order of their importance, are heart disease, cancer, pneumonia, nephritis, accidental violence, cerebral hemorrhage, tuberculosis, congenital malformations and diseases of early infancy, diabetes and influenza. The relative significance of these causes of death varies with the section of the country under consideration, but, for the country as a whole, they represent the ten leading causes of death. Heart disease is responsible for nearly 25 per cent. of all the deaths in the United States, and its annual toll is more than twice the number of deaths resulting from cancer. Many of the "Big Ten" represent the degenerative diseases. How much can be done to prevent mortality resulting from senility and from the wear and tear of daily living by recognized public health and medical procedures is decidedly problematical.

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[2] Richard H. Shryock, *Am. Jour. Public Health*, 27: 10, 965–971, October, 1937.

[3] *Public Health Reports*, 53: 18, 701–719, May 6, 1938.

[4] Metropolitan Life Insurance Company, *Statistical Bulletin*, 18: 11, 3, November, 1937.

[5] Metropolitan Life Insurance Company, *Statistical Bulletin*, 19: 8, 7, August, 1938.

Reference has been made already to the extension of the average expectancy of life at birth since 1880. This progress was not limited to the last two decades of the nineteenth century, but has continued into the twentieth century as well. The actual progress along this line since the beginning of the present century is indicated in Table 2.[5]

TABLE 2

EXPECTATION OF LIFE AT BIRTH AMONG TOTAL PERSONS (WHITE AND COLORED) AND AMONG WHITE PERSONS BY SEX FOR THE UNITED STATES FROM 1901 TO 1936

Year	Expectation of life at birth in years		
	Total persons	White males	White females
1936*	60.81	60.18	64.36
1935*	61.37	60.72	64.72
1934*	60.79	60.24	64.18
1933*	61.26	60.86	64.40
1932†	61.07	60.69	64.38
1931†	60.26	59.88	63.56
1929–1931	59.57§	59.31‖	62.83‖
1919–1920¶	....	55.33	57.52
1910‡ ...	51.49	50.23	53.62
1901‡	49.24	48.23	51.08

* Total United States.
† United States, excluding Texas.
‡ Original death registration states.
§ This figure relates to 1930 only for the United States, excluding Texas.
¶ Aggregate of 27 states; not computed for total persons.
‖ United States, excluding Texas and South Dakota.

During the first three decades of the twentieth century, the average expectancy of life at birth was increased by almost exactly eleven years—in spite of a devastating influenza-pneumonia epidemic and our participation in the World War with its attendant loss of life. Since 1930 there has not been any significant variation in average longevity. Perhaps the limit is being reached in our ability to prevent death with our present knowledge. It may be necessary for us to await the further contributions of the biologist, chemist and physicist in order to achieve additional success in deferring death. It is of interest to note, however, that at age 34 the average citizen has just as many years ahead of him as behind him; that at age 46, the average citizen may still look forward to a quarter century of life; and that even for those fortunate individuals who have attained the proverbial threescore years and ten, there still remain, on the average, 9.25 years of life.

According to Britten,[6] the causes of death listed in Table 3 were responsible for 81 per cent. of the total mortality in the United States in 1933.

TABLE 3

DEATH RATES PER 100,000 OF THE POPULATION IN THE U. S. IN 1933 BY SPECIFIC CAUSE, ARRANGED IN ORDER OF NUMERICAL IMPORTANCE

Cause of death	Death rate per 100,000 population
Diseases of the heart	228.0
Cancer and other malignant tumors..	102.2
Influenza and pneumonia	95.6
Nephritis and other kidney diseases..	85.7
Cerebral hemorrhage	84.0
Tuberculosis, all forms	59.5
Diseases of early infancy and congenital malformations	50.6
Automobile accidents	24.7
Diabetes mellitus	21.3
Diarrhea and enteritis	17.2
Arteriosclerosis	16.8
Suicide	15.9
Appendicitis	14.1
Puerperal state	10.3
Hernia and intestinal obstruction ...	10.0
Homicide	9.6
Gastritis	9.1
Syphilis	8.8
Cirrhosis of liver	8.7
Gall bladder diseases	6.9
Prostate diseases	6.0
Tumors, benign	4.6
Diphtheria	3.9
Tonsilitis	3.8
Malaria	3.7

The data presented in the preceding table indicate the principal causes of death in the United States and their relative importance. They are not always synonymous with the conditions or diseases that incapacitate an individual. They demonstrate once more that many of the conditions that result in death are due to the aging of the body or to non-preventable organic defects.

"Modern longevity is the product of modern enlightenment. Man himself, as a physical and physiological unit, has probably changed but little since remote antiquity. But man's power over his environment has changed immensely."[7] It would seem that man's increasingly effective mastery over a defective environment and his genius in developing biological and chemical agents for the prevention and treatment of certain diseases have been largely responsible for the progress that has been made. The demonstration of Pasteur that germs were responsible for fermentations and by Koch that germs were responsible for animal and human diseases made it possible to establish a new theory of the sources and modes of infection which in turn led to the virtual control of such diseases as typhoid fever, cholera, dysentery, paratyphoid fever and other ailments in this and other countries where public health progress has been marked. The demonstration by Theobald Smith that insects can be vectors of disease led eventually to the conclusive evidence by Ronald Ross that the anopheles mosquito was involved in the life cycle of the malarial parasite and its transmission to man. This work undoubtedly influenced the American Yellow Fever Commission in Cuba at the beginning of the twentieth century in their study of yellow fever which led ultimately to the demonstration that yellow fever is also a mosquito-borne disease. Thus two of the great scourges of man were attacked with newer knowledge and were brought under more effective control. The same held true for other insect-borne diseases, such as typhus fever and bubonic plague, as well as those diseases that are transmitted by flies. The effective control of the environment has brought under control in this country the intestinal and insect-borne diseases.

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[6] Rollo H. Britten, *Public Health Reports*, 51: 29, 947–969, July 17, 1936.

[7] Louis I. Dublin and Alfred J. Lotka, "Length of Life," p. 154. The Ronald Press Co., New York, 1936.

The establishment of the germ theory of disease was also responsible for the application of disinfectants and germicides to surgical wounds and to pyogenic infections of every variety, and led first to antiseptic surgery and later to aseptic surgery. It also stimulated research into the development of newer and better germicides. In this work many bacteriologists and chemists have cooperated. To these scientific workers the world is indebted for the introduction of new and better weapons in the conquest of disease, and for making it possible for surgeons to explore the human body with relative impunity and to perform radical operations to save human life which would have been impossible but a scant 50 or 60 years ago. The development of sulphanilamide in recent years is a good illustration of a life-saving contribution by a scientific worker. Likewise the discovery of x-rays and radium rays by physicists and chemists has had far-reaching effects both in the diagnosis and treatment of human disease. Many lives have been saved by the judicious use of germicidal agents; pyogenic infections have been prevented or controlled and surgery has been rendered safe beyond all human expectations. This success in preventing disease, controlling death and prolonging life is due to a more effective control of the environment.

Another aspect of environmental control which has had a profound effect on human health and vitality has been a combination of cleanliness, refrigeration and heat treatment in the production and safeguarding of many foods. In no instance is this success so obvious as in the protection of city milk supplies in the United States. An important but perishable food, often laden with dung and disease, has been sanitated, refrigerated and rendered safe through pasteurization. As a result, milk-borne diseases, including typhoid fever, diphtheria, scarlet fever, septic sore throat, undulant fever and tuberculosis of bovine origin, have been brought under control, and rarely occur in our large cities, where all or nearly all the milk supply is pasteurized. In all probability, there is not another country in the world where the milk supply is as clean and as safe as it is in the United States. The significance of this condition in infant and child health and in the nutrition and health of the entire population can hardly be over-estimated.

What has been accomplished in sanitating and safeguarding our public milk supplies has been matched with equal effectiveness in the purification and protection of our public water supplies and in the protection and safety of other aspects of our food supply. Most of this has been achieved through engineering effort—man's effective control over his environment to protect his health and to promote his comfort and convenience. When one realizes that billions of gallons of water are used and consumed in the United States every day; that this vast amount of water is purified or safeguarded and then rendered safe usually by chlorination; that one may travel the length and breadth of a great and populous continent and feel reasonably certain that the water can be consumed in the raw state with impunity; that this magical accomplishment so essential to health and life must be repeated without interruption day after day; only then can one begin to appreciate the debt which society owes to the activity of the public health engineer. Any serious interruption in the continued flow of water to our large cities or any serious infection of the public water supply which was not eliminated or controlled would make a mockery of our urban civilization and would create an epidemic situation that would make the pandemic of influenza-pneumonia of 1918 seem like a mild outbreak of disease.

Through other engineering developments in the fields of refrigeration, cold storage and rapid means of transportation, coupled with sanitary and veterinary inspections, our solid food supply has been safeguarded and delivered to every community in a fresh condition. Food is the source of all human energy and for that reason is basic in the maintenance of life and in building up the vital resistance of the body against disease. A clean, fresh and wholesome food supply is a basic public health requirement. Happily through the use of cookery—another step in man's control over his environment—our clean, fresh and wholesome food supplies have also been rendered absolutely safe.

The construction of a new road or a new link to a main railroad may mean more in promoting the health of a community than any other thing the community may do. Rapid means of transportation are essential for bringing food into the community in sufficient variety and freshness. Rapid means of transportation are also necessary to bring tools and other equipment into a community in order to aid the people in their efforts to master their environment; and control over one's environment is essential for promoting and maintaining good heatlh.

The construction of sewers and the building of sewage treatment plants have done much to remove a nuisance and menace to health in the vicinity of the home. Because sewage treatment hasn't kept pace with sewer construction, the improper disposal of sewage has created newer public health problems which demand solution. Public water supplies, shellfish growing areas, bathing places and recreational and camp sites must be protected against sewage pollution. The country is slowly but surely making progress in the elimination of some of the worst cases of pollution. Chicago altered the natural course of a river in order to avoid polluting its drinking water with its own sewage. Since then it has built sewage treatment works to cope with the problem of pollution more effectively. New York, New Haven, Providence, Baltimore, Milwaukee, Indianapolis and many other cities have built sewage treatment plants and are operating them continuously. It is expected that badly polluted streams will be improved; that fish life will return; that land values will improve and that the other undesirable features of uncontrolled sewage pollution will be prevented or greatly ameliorated.

The introduction of the water closet into the home and the provision of adequate plumbing facilities with hot and cold running water has doubtless had a very significant effect on the health, comfort and convenience of a great portion of the population. However, it is impossible to evaluate its significance in terms of preventable diseases and deaths. It has eliminated the privy from the vicinity of the home with its attendant nuisances and health hazards. It has helped to suppress flies. It has favored intestinal hygiene throughout the year. It has made for human comfort, convenience and decency. It has promoted hand hygiene, mouth hygiene and body cleanliness. It has stimulated sanitation in the home and the cleanliness of foods and eating utensils. It represents another environmental factor which has definite public health significance.

In rural areas and in unsewered sections of cities, the construction of fly-tight privies has controlled soil pollution and the breeding of flies and has served as a factor in the control of intestinal diseases, including hookworm. This public health engineering activity also represents an advance in man's effective control of his environment.

Other items in man's control of his environment which have promoted the public health in the broadest sense include the control of insects and rodents, the sanitation of food stores and restaurants, the sanitation of public buildings and public conveyances, the removal and proper disposal of all forms of municipal refuse, the sanitation of shellfish and shellfish growing areas, of swimming pools and bathing places, of summer camps and tourist camps, boarding houses, hotels and other similar places. In addition, campaigns against noise, smoke, odors and other community nuisances have been waged and effective results obtained in many instances. The problem of heating and ventilation and of air conditioning in general has received a great deal of consideration. This is true both for domestic residences as well as for business and industrial establishments. As a result, air-conditioning in the home is becoming more adequate and satisfactory; while in industry excessive dusts, heat and humidity and obnoxious or injurious fumes, vapors and gases are being removed. The relationship of sunlight to physical and mental health has also received some consideration, as well as the removal of the agents of disease from the atmosphere of large assembly halls. These factors affect the vital resistance of the individual and hence the public health.

Reference has been made to the improvement of man's industrial environment and its effect on his health and comfort. Included in the same category are the prevention of industrial accidents of all types, improvement in illumination, avoidance of excess fatigue and over-exposure, the provision of rest periods, the curtailment of the work-day, the provision of vacations with pay and the whole gamut of changes in the industrial structure which consider the health and well-being of the worker to an ever-increasing degree. Recently, there has been a rapid acceleration of interest on the part of public health workers in the field of industrial hygiene and sanitation. In many instances state divisions of industrial hygiene have been formed under the auspices of the health department. Most of the larger industries have had such divisions of their own for many years, and these invariably have produced very satisfactory results. In nearly every state, special statutes exist which regulate the conditions of employment and which aim to protect and promote the health and welfare of the worker.

Industrial hygiene and sanitation have two aspects, medical and engineering. The engineering aspect includes the chemical where such problems exist. It is obvious that from the standpoint of environmental control in industry—that control which affects the health and welfare of *all* the workers in a factory or a part of it—the engineering aspect is of predominant importance. It is another sphere of public health activity in which the public health engineer has played and is continuing to play in a greater measure a rôle of real importance.

Still another aspect of environmental control which is receiving increasing attention is the matter of providing healthful housing for our population. The problem is an old one, and much improvement has been accomplished over the past five or six decades. The issue has been elevated to a position of national importance and concern through the appropriation of vast sums of money by the Federal Government for slum clearance, and through the activity of the American Public Health Association Committee on the Hygiene of Housing as well as other groups. Healthful housing conditions favor good health in a variety of ways, and since the home is the environment of the individual for 8 to 24 hours each day, its public health significance is of appreciable importance. It involves such questions as water supply, sewerage, refuse disposal, drainage, insect and rodent control, lot overcrowding, congestion in the home, safety from fire and accidents, air conditioning, access to sunlight, freedom from noise, odor and smoke nuisances, play space for children and various other items of significance to the public health in the broadest sense.[8]

Another environmental factor which has had an unmeasurable but significant effect on the prevention of disease and premature mortality and the promotion of good health has been the improvement in the standard of living. Working hours have been reduced, rest periods in industry have been introduced, the minimum age of employment has been fixed by law in many instances and real wages are more satisfactory than in any other country in the world. Added to this improvement in social conditions has been the great progress in industrial hygiene and sanitation outlined above. More significant still is the revolutionary change in our knowledge of what constitutes an adequate and satisfactory diet and the application of that knowledge to the daily lives of our people. While much progress can still be made in the scientific and adequate feeding of our population, the fact remains that the wide-spread use of vitamins and minerals in the diet, coupled with proteins, carbohydrates and fats, has helped to build up and maintain the resistance of the population against disease. Adequate and satisfactory nutrition is the foundation on which the public health must rest.

This conclusion is supported by the happy but anomalous experience of the depression period, 1930–1936. In spite of wide-spread unemployment and curtailed health department budgets; in spite of diminished public health clinical and nursing activities, the health of the people either did not suffer at all or did not suffer sufficiently to be reflected in the death rates. As a matter of fact, the general death rates for the period under consideration showed a downward trend and the average expectancy of life at birth actually increased somewhat. This is borne out by the statistics cited in Table 4.[9] We have the apparent anomaly, therefore, that the public health in the United States seemed to improve during great economic distress and in spite of curtailed health department budgets.

TABLE 4

General Death Rate, United States Registration Area, 1921–1936

Year	Death rate per 1,000 population
1921	11.6
1922	11.7
1923	12.2
1924	11.7
1925	11.8
1926	12.3
1927	11.4
1928	12.1
1929	11.9
1930	11.3
1931	11.1
1932	10.9
1933	10.7
1934	11.0
1935	10.9
1936	11.5
1937	10.9*

* Based on data for 40 states representing 85 per cent. of the total United States population. Cited in *Public Health Reports*, 53 : 18, 708, May 6, 1938.

What are the reasons for this anomaly? Perhaps they will never be known. Certainly no public health worker would advocate the curtailment of health department appropriations as a means of cutting the death rate and extending the life span. The answer, I believe, is found in the fact that the public health is intimately dependent on the control of the environment and that public health clinical activities are not important to the same degree. During the depression, our public water supplies were still purified, our sewers continued to function, public milk supplies were still safeguarded by pasteurization, food supplies were still safeguarded as to freshness, wholesomeness and absence of infection, and above all nobody was allowed to die of starvation or of cold. As a matter of fact, relief agencies insisted on at least a minimum but entirely complete and well-balanced diet, and the same agencies provided fuel for protection against the cold. As a result, the vital resistance of the people was maintained and excess disease and deaths did not occur. There were also certain definite public health advantages that can be credited to the depression. Exposure to industrial hazards and accidents was greatly diminished, smoke pollution of the atmosphere was greatly abated and people had more time for rest and relaxation. As a result, even the death rate from tuberculosis[10] continued downward rather than upward, as might have been expected, for in 1933 the rate in 41 states was 55.5 per 100,000 population; in 1934, it was 52.9; in 1935, 51.6; in 1936, 51.7 and in 1937, 49.6.

Another environmental factor which has had a real but unmeasurable effect on health and vitality has been the conscious provision of playgrounds, parks and recreational facilities for the people. Coupled with this has been the growing practice of providing vacations with pay for the industrially employed. In France and Germany this practice has been fostered by the state. In the United States, it is largely the responsibility of private business and industry. Whatever the auspices, the body has an opportunity for periodic rest and relaxation without financial anxiety, and this, coupled with life in the open to a greater or lesser extent, has a beneficient effect on the public health.

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[8] M. P. Horwood, "Housing and Health." *The Commonhealth* (Mass. Dept. of Public Health), 25: 95–102, June, 1938.

[9] *Public Health Reports*, 53: 5, 168–171, February 4, 1938.

[10] *Public Health Reports*, 53: 701–719, May 6, 1938.

Finally, the significance of the environment in the public health picture can be appreciated also by imagining what would happen in a short time to our much-vaunted civilized security if we ceased to protect our water supplies or interrupted their distribution; if the sewerage systems of our cities ceased to function; if garbage and other refuse materials ceased to be removed from the home by organized methods; if city milk supplies ceased to be pasteurized or heated in the home; if all industrial safeguards were suddenly removed and ceased to function. It is very simple to visualize what would happen, for New York City had two experiences recently that illustrate very graphically that human health and well-being are fundamentally dependent on the continued and effective control of the environment.

The first condition resulted when the flow of electric current below 59th street was interrupted for a brief period—30 minutes or more—shortly after 5 P.M. during the winter season. The subways and elevated lines ceased functioning at the hour of maximum demand; elevators in buildings stopped operating; electric heaters and electric refrigerators ceased to function; likewise electric pumps for water, milk and all possible uses; houses, stores, offices and city streets were thrown into utter darkness and people into utter panic because of fear of theft and the unleashing of man's worst instincts. Here the continuance of public health and public safety was dependent on the prompt resumption of the flow of electricity—a purely environmental factor.

The second illustration refers to the strike among the elevator operators in Manhattan. It is only necessary to mention such a condition to one familiar with the situation in New York to appreciate its public health significance. Elderly people with weak hearts could not do much climbing without running serious risk of irreparable damage. All the food had to be carried upstairs and the seriousness of this problem can be easily recognized. All the garbage had to be carried or thrown downstairs and one can readily imagine that even the fashionable environment of Park Avenue suffered somewhat. We must agree with Wolman[11] that "civilization rests upon a thin crust of environmental protection."

Charles Gilman Hyde[12] has presented a very thorough picture of the indispensability of the public health engineer to-day. Those individuals who say glibly that the public health movement has evolved through three stages—the control of the environment, the period of the bacteriologist and the period of the physiologist—and who say further that the era of environmental sanitation is behind us, know not whereof they speak. The era of environmental sanitation must be with us constantly if we are to maintain the great gains in human health that have been accomplished; and the control of the environment in the broadest possible sense must be extended to new limits if we are to meet the other aspects of healthful living—the promotion of the comforts and convenience of organized society.

This review has shown, I believe, that there exists an intimate relationship between the effective control of the environment and the great progress that has been made during the past 50 or 60 years in preventing disease and premature mortality, in extending the average expectancy of life at birth and in promoting joyous, healthful living. The control of the environment has not been the only factor involved, as will be demonstrated presently, but that it has been very significant can not be denied. Further support of the significance of effective environmental control in promoting the public health even to-day was presented at the convention of the American Public Health Association in New York in 1937 by Dr. Livingston Farrand, president-emeritus of Cornell University, who said at one of the great general meetings that "the two outstanding public health problems in the United States to-day are housing and nutrition." The first includes the elimination of slums and low standard housing areas and their replacement with suitable housing facilities; while the second deals with the important problem of providing an adequate and properly balanced diet for every man, woman and child. Both factors affect the public health through their influence on the vital resistance of the individual; while the housing factor also plays a rôle in his comfort and happiness.

In addition to the work of the public health engineer various other factors have played important parts in the public health progress that has been made since 1880. During this period, bacteriology has blossomed into a highly developed science. Not only have many of the etiological agents of disease been determined, but numerous laboratory aids in the diagnosis of disease have been developed. These have assisted greatly in making early and definite diagnoses—a prerequisite to effective treatment and even to the prevention of secondary cases in certain diseases.

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[11] Abel Wolman, *Am. Jour. Public Health*, 27: 1, 43–49, January, 1937.

[12] Charles Gilman Hyde, *Am. Jour. Public Health*, 26: 7, 697–710, July, 1936.

Another factor has been the development of biological products for the diagnosis, prevention and treatment of certain diseases. It is unnecessary to list all of them here, since the student of public health is quite familiar with them; but typhoid vaccine, smallpox vaccine, toxoid, antitoxin, anti-pneumococcus serum and various other biological agents are well known tools in the prevention and control of disease. Biological therapy will doubtless be replaced eventually by chemo-therapy, for through the activities of the biochemist and the organic chemist the structure and composition of immune substances and immunizing agents will be determined and subsequently synthesized outside the body. Already some of the vitamins and hormones have been synthesized and specific chemical substances are available for the treatment of specific diseases. The chemist and physicist are destined to make important contributions to our understanding of the mechanism of immunity and the composition of immunizing substances.

Still another factor that has played a part in the public health progress of the past 60 years has been the work of the statisticians. They have determined death rates and their trends. They have determined specific death rates for every cause of death and have analyzed these rates by age, sex, nativity, color, racial origin, occupation, economic status, religious affiliation, ward of residence, illiteracy and various other factors. In this way, a vast amount of epidemiological information has been assembled and utilized in planning the public health campaign. It has meant that the available funds could be spent more wisely and effectively.

Still another factor which has played a significant but unmeasurable rôle in the public health progress of the past 60 years has been the great campaigns of personal and popular health education. These campaigns have dealt with hygienic living; with the need for immunization against diphtheria, typhoid fever and smallpox; with the requirements of an adequate and properly balanced diet; with the importance of consuming milk in adequate amounts, especially pasteurized milk; with pure water; with proper excreta disposal; with the importance of controlling flies, mosquitoes and other insects as well as rodents; with the importance of dental care and early diagnosis in the detection of tuberculosis; with prenatal hygiene, infant and child hygiene; with the abatement of housing evils and atmospheric pollutions; with the importance of detecting and eliminating physical defects and the desirability of periodic, competent medical examinations. Campaigns of education have been waged against cancer, organic heart disease, the genito-infectious diseases and various other important human maladies. These campaigns have been waged in the public press, through other printed material, through lectures and demonstrations, through classes and through the aid of the public health nurse in the home and clinic. Attending physicians at clinics have frequently aided in this program of enlightenment. The public schools have been literally bombarded with health educational material, and the curriculum has been modified to include instruction in the essentials of healthy living. Such a campaign, conducted on so gigantic a scale, and one which has been so persistent must have had some effect, even though its magnitude is not measurable. Its potential value is appreciated by every progressive health officer and public health worker.

Since the tools of public health education consist of the printed and spoken word, pictures and demonstration material, and the intelligent use of scientific information coupled with a knowledge of mass psychology, this significant contribution to public health progress may also be considered an aspect of environmental control.

It is relatively simple to account for the great progress in the control of the intestinal and insect-borne diseases through the more effective control of the environment. It is also a simple matter to account for the control of such diseases as diphtheria and smallpox through the extensive use of suitable biological products for prevention, diagnosis and treatment. How can we account for the remarkable progress against tuberculosis? For tuberculosis is a respiratory disease very largely, and there has not been available a specific biological agent for immunizing susceptible individuals or treating those who are ill. Recently, of course, the developments of new surgical technique have made it possible to place a diseased lung at rest, a practice which has proven even more efficacious in hastening the healing process than bed rest. It is important to remember, however, that much of the great progress against tuberculosis occurred before the advent of surgical aids in the treatment of this disease. Accordingly, it is important to look for other causes to explain this remarkable phenomenon.

There are very few diseases that are so intimately linked up with the vital resistance of the body as tuberculosis. The rise in the mortality from tuberculosis during the World War in Austria, Germany, England and France lends support to this view. Doubtless the improvement in all the environmental factors affecting health—such as more adequate and complete nutrition; safe water supplies; pasteurized milk supplies; clean, wholesome, safe foods; increased sewerage facilities; shorter working hours; better working conditions; vacations and rest periods; health education; better housing; and the improvement in general health and vitality following the more effective control of other diseases—has had its beneficent effect on the prevalence and mortality from tuberculosis. This does not minimize the importance of the development of laboratory aids in the diagnosis of tuberculosis and of the establishment of tuberculosis clinics for the early diagnosis of the disease and of sanatoria and hospitals for the effective treatment of the disease. But it does indicate quite definitely that the more effective control of the environment has played a part, and in all probability a large part in the progress made against tuberculosis.

Recently[13] the *Journal* of the American Medical Association, quoting from a study by Georg Wolff on "Tuberculosis and Civilization," published in *Human Biology* for May, 1938, lists five of the possible factors that have reduced the mortality from tuberculosis in the last 50 years from approximately 300 per 100,000 population to 50 per 100,000 population. The factors enumerated are: (1) a specific factor; (2) an hereditary factor; (3) a social factor; (4) a population factor; and (5) a medical prophylactic factor. Of these, the social factor is considered the most important and the items enumerated under this heading include improvement in economic well-being; better housing; better nutrition; better working conditions; smaller families; and hygienic education. As noted above, these factors are aspects of the environment of man, the improvement of which has been a fundamental cause in his superior well-being.

Phenomenal progress in preventing disease and premature mortality has also been made among infants and pre-school children. It is therefore desirable to inquire into the factors that have been largely responsible for the saving of human life in these very vulnerable age groups. An analysis of the statistical data available points very definitely to the fact that the control of the environment has been the dominant factor. Dublin and Lotka[14] show that in New York City in 1872 the death rate from diarrhoeal diseases under 5 years of age was equal to 40 per 1,000 of the population under 5 years; whereas by 1931, the death rate from this cause was down to 1 per 1,000. This remarkable improvement in the control of diarrhoeal diseases in children is due to the better control of all the environmental factors involved as well as the introduction of more scientific feeding. The control of diarrhoeal diseases in children alone would account for much of the life saving that has been witnessed in this group. If to this factor be added the saving of human life due to biological products used for prevention, diagnosis and treatment, and the improvement in the robustness of children due to improved hygiene, the significance of an improved environment on human welfare becomes more apparent.

If the factors responsible for the diminution of infant mortality be studied, a similar conclusion results. Dublin and Lotka[15] show the trend in infant mortality by cause for the U. S. Birth Registration States of 1917 for the period 1917–1932. The authors conclude that "the great gain that has been scored in preserving infant life has been due very largely to our success in dealing with this one item of diarrhea and enteritis. A large number of factors have undoubtedly contributed to the great improvement which has taken place in the mortality from this disease. Among the contributing factors should be mentioned particularly the introduction of the compulsory pasteurization of milk and the increasing spread and the greater perfection of methods of refrigeration; the education of mothers regarding the proper feeding of infants; attention to cleanliness of food and the avoidance of unripe fruit; the improvement in the quality of public and domestic water supplies; and the general awakening to the menace of flies as carriers of disease."

If infant mortality is studied by months, it will be found that approximately 60 per cent. of all infant deaths occur during the first month of life, and most of these during the first week of life. These infant deaths are most closely associated with the lack of suitable prenatal and obstetrical care and have shown remarkable constancy in some cases, while in others the rates have actually gone up. Infant death rates due to syphilis, congenital malformations, influenza and pneumonia, premature birth, whooping cough and bronchitis and broncho-pneumonia have either remained stationary or have receded very, very slowly, while the infant death rate due to injuries at birth has actually increased. Only recently have the neonatal infant mortality rates begun to come down in those enlightened and progressive communities where special campaigns have been waged.

Finally, the practice of medicine has undoubtedly played a part in the splendid public health achievement of the past 50 or 60 years. Surgery, aided by antisepsis and asepsis, by x-ray photography and by advances in our knowledge of general physiology, has unquestionably saved the lives of countless thousands of ailing humans. It has also promoted the comfort and well-being of other countless numbers whose lives were not in jeopardy. Improvement in laboratory diagnostic techniques as well as the establishment of public health clinics and outpatient department services have promoted the early diagnosis of disease which in turn has made it possible to place the patient under prompt and effective treatment in many cases. Good nursing has also done its share in helping the body recover a state of health after medical treatment had been provided. The conclusion that can be drawn from this exposition is that the great public health achievements of the past 50 years are the result of the joint efforts of engineers, social workers, physicians, dentists, nurses, statisticians, epidemiologists, health educators, public health administrators, chemists, physicists, sanitary biologists and doubtless many others. Public health progress is emphatically not due to the activity of any one professional group.

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[13] *Journal, Am. Med. Asn.*, 111: 11, 1020–1021, September 10, 1938.

[14] *Loc. cit.*, p. 156.

[15] *Ibid.*, p. 163.

Now that many of the communicable diseases have been brought under control by the methods described in the previous section, and such diseases as organic heart disease, cancer, nephritis, arterio-sclerosis, diabetes and other degenerative diseases have assumed increasing importance because of their high mortality, it is interesting to inquire how further public health progress is likely to be made. It is obvious that in so far as focal infections and communicable diseases are associated with the etiology of the degenerative diseases, their early discovery and elimination through expert medical service is of great value. Unfortunately, the degenerative diseases and cancer affect the population during the later adult periods of life and are apparently the result of physiological derangements of the human mechanism, the causes of which are still unknown. Early diagnosis and effective medical treatment in these degenerative diseases of later adult life may be palliative, but as yet they have not been successful in prolonging life to any appreciable degree. In order to accomplish this desirable end it is necessary to know how and why the degenerative diseases have their onset and to determine the best methods of prevention and control. Why does the body grow old and show the well-known symptoms of degeneracy and decay? What takes place within the body cells when senescence occurs? What keeps cancer in check during the early years of life in most cases and what occurs in the body later on in the very same human beings? The answers to these questions can not be found in the public health or hospital clinics. The answers must be found in the research laboratories, through the work of chemists, physicists, biochemists, organic chemists, bio-physicists, physiologists and other highly trained men in the various fields of science. In other words, further progress in prolonging the average life span of man at birth must depend on the significant contributions emerging from the various research laboratories.

At the present time, the evidence seems clear that those who reach the mature age of 80 years or more have usually come from long-lived parents. Such people seem to be able to overcome the hazards which are frequently fatal to those of shorter-lived ancestry. Heredity seems to play a far more important role in determining longevity than many of the factors normally regarded as significant. The effect of heredity on longevity is indicated by the data in Table 5.

TABLE 5

EFFECT OF PATERNAL HEREDITY ON LONGEVITY OF SONS[16]

Age of son at death, in years	Per cent. having fathers who died at age 80 or over
Under 20	24
20–39	21
40–59	27
60–79	38
Over 80	46

Great emphasis is being placed in the current public health campaign on the control of the genito-infectious diseases and pneumonia. Control, however, in these diseases is also based on the use of certain laboratory procedures for diagnosis, and on either chemo or sero therapy. It is apparent therefore that suitable control of the environment, including health education, also plays a rôle in the control even of these diseases.

The preceding analysis has brought out, I believe, the significance of the more effective control of the environment on the prevention of disease and premature mortality and on the prolongation of the average life span at birth. Coupled with a declining birth rate and with the restrictions that have been placed on immigration, the population of the United States has been growing older. This is evident from the larger proportion of the population now found in the later age groups. Older people must have and insist upon having a comfortable environment. Accordingly, the public health movement of the immediate future is destined to see greater emphasis on the comfort and convenience of man as well as a continuing emphasis on the prevention and control of disease. The former will undoubtedly include air conditioning, noise abatement, improved housing, smoke abatement, clean streets, parks and recreation centers, abatement of nuisances due to odors and unsightly conditions, stream purification and other items that fall within the realm of activity of the public health engineer. It would seem therefore that the importance of the public health engineer in organized community life is destined to increase rather than diminish.

SCIENTIFIC EVENTS

THE CONVERSAZIONE OF THE ROYAL SOCIETY

THE Royal Society held the first of its two annual conversaziones in its rooms at Burlington House, London, on May 24, when as usual a number of exhibits were displayed.

The London *Times* states that prominent among the exhibitors were various departments of the British Museum. Its department of zoology sent a series of armadillos, an example of camouflage in a nightjar and turtles stranded on the coasts of the British Isles; its department of geology flexible sponges of Oligocene age from Ukraine and casts of the skull and other parts of a large fossil amphibian from New South Wales; and its department of mineralogy a beautiful specimen of Danburite, a rare gem stone from Burma; while its research laboratory and department of ethnography illustrated the application of x-rays to the study of old Peruvian pottery.

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[16] *Ibid.*, p. 139.

From Kew Gardens came specimens showing the resupination of the flowers of laburnum and other plants, and the origin of the garden plum was illustrated by the John Innes Horticultural Institution. The National Physical Laboratory showed radio-transmitting equipment for use with meteorological sounding balloons, and an apparatus for measuring extremely minute differences in water pressure, and the Cavendish Laboratory, Cambridge, a new form of x-ray microscope which converts a series of measurements on x-ray beams diffracted by a crystal into an optical image of the crystal that can be viewed through an eyepiece.

Among exhibits from the Imperial College of Science and Technology were instruments for the microscopy of ores, a small internal-combustion engine running on methane and apparatus for measuring the oxygen consumption of flying insects and determining the effect of atmospheric pressure on the frequency of their wingbeat.

The director of research of the Admiralty demonstrated the rapid spectro-chemical analysis of alloy steels, and Dr. W. H. Hatfield, of the Brown-Firth Research Laboratories, showed non-magnetic steels and examples of different methods of obtaining extremely hard metallic materials. Sir Robert Hadfield showed a quick-immersion thermo-electric pyrometer for measuring the temperature of liquid steel and apparatus for the rapid estimation of carbon in steel.

Photographic exhibits sent by George H. Gabb included examples of early Talbotypes and Daguerreotypes, among them being what is probably the earliest attempt to photograph the solar spectrum, dating from 1842.

A CONFERENCE ON THE CALCULUS OF VARIATIONS

A CONFERENCE on the calculus of variations will be held at the University of Chicago from June 27 to 30 under the auspices of the department of mathematics. The speakers and the topics which will form the basis for discussion at the conference are as follows: Tibor Radó, of Ohio State University, "Length and Area" and "Geometrical Approach to the Plateau Problem"; Jesse Douglas, of the Institute for Advanced Study, "The Problem of Plateau-Riemann" and "Minimal Surfaces of Higher Topological Structure"; Marston Morse, of the Institute for Advanced Study, "Functional Topology and Analysis in the Large" and "The Existence of Minimal Surfaces of General Critical Type"; Karl Menger, of the University of Notre Dame, "Logical Analysis of the Semi-continuity Properties of Line Integrals"; E. J. McShane, of the University of Virginia, "Existence Theorems for Minima of Simple and of Multiple Integrals"; Max Coral, of Wayne University, "The Equations of Haar and the Differentiability of their Solutions"; G. A. Bliss, of the University of Chicago, "The Field Theory for Multiple Integrals"; L. M. Graves, of the University of Chicago, "The Jacobi Condition for Minima of Multiple Integrals"; M. R. Hestenes, of the University of Chicago, "The Problem of Bolza"; W. T. Reid, of the University of Chicago, "Sufficiency Proofs for the Calculus of Variations by Expansion Methods"; H. H. Goldstine, of the University of Chicago, "Minimum Problems of Abstract Functional Calculus." Discussion of some of the problems and results presented in the lectures of the conference will be continued in a seminar on the calculus of variations conducted by G. A. Bliss, and lasting through the summer quarter. Among those who will participate in the seminar are Max Coral, H. H. Goldstine, L. M. Graves, M. R. Hestenes, E. J. McShane, W. T. Reid and M. F. Smiley. A series of lectures preparatory to the addresses of the conference will be given in the seminar in the preceding week, from June 21 to 24. All mathematicians and other scientists who may be interested are cordially invited to attend the conference and the preparatory lectures in the seminar. Requests for information concerning the conference and housing accommodations may be addressed to Professor M. R. Hestenes, Eckhart Hall, University of Chicago.

L. M. GRAVES

THE ATLANTIC CITY MEETING OF THE AMERICAN SOCIETY FOR TESTING MATERIALS

THE forty-second annual meeting of the American Society for Testing Materials will be held at Chalfonte-Haddon Hall, Atlantic City, from June 26 to 30. There will be given upwards of a hundred and ten technical papers and reports in the fields of standardization, research and testing of engineering materials. The subject of the annual address of the president, T. G. Delbridge, manager of the research and development department of the Atlantic Refining Company, will be "Glimpses at Petroleum," and the fourteenth Edgar Marburg Lecture will be by Professor H. F. Moore, on "Stress, Strain and Structural Damage."

Throughout the week of the meeting the fifth Exhibit of Testing Apparatus and Related Equipment will be in progress. The exhibit will open at noon on Monday. Many leading commercial companies concerned with the manufacture and distribution of testing apparatus and related equipment, measuring and recording instruments, laboratory supplies and related scientific instruments will be among the exhibitors. A number of instruments will be on display for the first time. In addition, several committees of the society are sponsoring displays illustrating important parts of their work. There will also be in progress the second Photographic Exhibit and Competition on the theme "Testing and Research in Engineering Materials." A separate section will be given to photomicrography.

On Monday the whole day will be devoted to committee meetings, which will continue through the remainder of the week. The first formal session will open at 10:30 o'clock on Tuesday morning, June 27. The second session in the afternoon, a Symposium on Paint Testing, with ten to twelve informal papers covering particular tests and their significance, will be held simultaneously with the one on iron, including several papers on cast iron and malleable iron castings. Two evening sessions on Tuesday are devoted to water, with five technical papers and two reports on this subject; and a round-table discussion of effect of subatmospheric temperatures on the properties of metals.

The session on Wednesday morning will be devoted to paper, plastics, rubber, glass and electrical insulating materials. This session runs concurrently with the one on fatigue and corrosion, there being four items dealing with fatigue and five covering corrosion. Reports on soaps, textiles and timber will follow on Wednesday afternoon, with a simultaneous session on coal, petroleum products and gaseous fuels. The Edgar Marburg Lecture will be given on Wednesday at 4 P.M., and at this time the award of the Charles B. Dudley Medal will be made. The evening session covers radiography, magnetic testing and metallography, there being four items in the field of radiographic testing by well-known authorities. At the time there will be a session dealing with soils, with a symposium on Shear Testing of Soils. Six papers by prominent technologists form the basis of discussion.

Thursday morning will be devoted to steel, ferroalloys and the effect of temperature. Two other sessions run concurrently with this—one on bituminous materials and road materials and the other round-table discussion on quantitative spectrography. A round-table discussion on Thursday afternoon on freezing-and-thawing tests will determine whether any organized work should be undertaken by the society in this field. The fourteenth session involves ceramic and masonry materials. Several papers will be given at the fifteenth session on methods of testing. Discussions will concern cement, concrete, lime and gypsum. The concluding session will include twelve papers and reports on non-ferrous metals.

THE GEOLOGICAL SOCIETY OF AMERICA

THE Geological Society of America, Section E of the American Association for the Advancement of Science, the Association of American Geographers and the American Society of Agricultural Engineers will join in meetings at Milwaukee during the week of June 19. The Upper Great Lakes region will provide the general theme for scientific sessions and excursions.

The following excursions have been arranged:

June 15–17.	To the iron and copper districts of northern Michigan, leaving Marquette, Michigan, 8 A.M., June 15. R. M. Dickey, leader.
June 19–22.	Local trips, with Milwaukee as base. Ira Edwards and F. T. Thwaites, leaders.
June 24–27.	To the Baraboo-Devils Lake region, Wisconsin. E. F. Bean, leader.

Those interested in participating in the excursion to northern Michigan or in the excursion to the Baraboo region, Wisconsin, are asked to communicate with the Secretary of the Section, H. A. Meyerhoff, 88 Crescent Street, Northampton, Mass. Plans were made on the basis of the registration on June 1, although later registration is not precluded.

The program and abstracts of papers to be presented at the summer meeting to be held at the University of California, Berkeley, on August 8, 9 and 10, will be distributed in June. Those wishing to participate in the local excursions on August 10 and from August 11 to 14, and in the excursion arranged for Los Angeles on August 17, who have not already sent in their names, are urged to communicate at once with C. A. Anderson, secretary of the Cordilleran Section, University of California, Berkeley.

As previously announced, the Paleontological Society, the Society of Economic Geologists and the Seismological Society of America will hold meetings at Berkeley in conjunction with the meeting of the Geological Society.

SEVENTH INTERNATIONAL CONGRESS OF GENETICS

PLANS for the Seventh International Congress of Genetics, to be held from August 23 to 30 in Edinburgh, are now fairly complete. The meetings will be held in the university departments at King's Buildings on the outskirts of the city. The Organizing Committee has selected Dr. N. I. Vavilov as president of the congress, and the secretary-general is Professor F. A. E. Crew, of the Institute of Animal Genetics at Edinburgh.

The sectional programs with their recorders will include the following:

A. "Gene and Chromosome Theory": H. J. Muller, Edinburgh.
B. "Cytology": C. D. Darlington, Merton Park.
C. "Physiological Genetics": B. Ephrussi, Paris.
D. "Animal Breeding in the Light of Genetics": A. D. Buchanan Smith, Edinburgh.
E. "Plant Breeding in the Light of Genetics": K. Mather, Merton Park.
F. "Human Genetics": G. Dahlberg, Uppsala.
G. "Genetics in Relation to Evolution and Systematics": J. S. Huxley, London.
H. "Statistical Genetics": R. A. Fisher, London.
I. "Genetical Aspects of Growth, Normal and Abnormal": C. C. Little, Bar Harbor.

A pre-congress tour from London to Edinburgh by motor bus has been arranged. The party will meet in London on Tuesday, August 15. Wednesday and Thursday will be spent in visiting various university departments and research institutions. On Friday the party will go to Cambridge by motor coach, there to spend the afternoon and the whole of Saturday in visiting the university departments, colleges and research institutions. On Sunday the party will leave for Chester, traveling through typical English scenery to reach this city steeped in historic associations. On Monday the journey will end at Windermer, the center of the English lake district. On Tuesday the party will cross the border at Carlisle, travel through the border hills, and reach Edinburgh in the late afternoon.

Several post-congress tours have also been arranged. These comprise three-, four-, five- and six-day tours in the lake regions of Scotland.

During the week of the congress a number of social functions have been arranged; *e.g.*, reception by the city of Edinburgh; congress banquet in the library hall of the university; visits to art galleries, museums and places of historic interest, etc.

Approximately sixty American geneticists have signified their intention to attend the congress. The Genetics Society of America is aiding in travel arrangements for their members and guests. (General travel information may be had from the secretary, E. W. Lindstrom, of the Iowa State College, Ames, Iowa.) Members planning to ship exhibit material requiring customs or quarantine inspection should write the representative of the society, Dr. M. M. Rhoades, Arlington Farm, U. S. Department of Agriculture, Arlington, Va.

RECENT DEATHS

DR. DAVID TODD, emeritus professor of astronomy and navigation and director of the observatory of Amherst College, died on June 1. He was eighty-four years old.

DR. EDWIN LINTON, professor emeritus of biology of Washington and Jefferson College, died on May 5 at the age of eighty-four years.

DR. JOSEPH GRINNELL, professor of zoology and director of the Museum of Vertebrate Zoology at the University of California, died on May 29 at the age of sixty-two years.

DR. CHARLES FREDERICK LORENZ, consulting engineer, from 1910 until his retirement in 1930 a member of the departments of physics of the Nela and the Westinghouse Research Laboratories, died on May 30 at the age of sixty-four years.

DR. ALFRED FRIEDLANDER, professor of medicine and dean of the College of Medicine of the University of Cincinnati, died on May 28 at the age of sixty-seven years.

DR. E. ROSS FAULKNER, for sixteen years surgical director of the Manhattan Eye, Ear and Throat Hospital, died on May 29 at the age of sixty-three years.

A CORRESPONDENT writes: "Alfred W. Anthony, ornithologist, died in San Diego, Calif., on May 14 at the age of seventy-three years. He was one of the pioneer field naturalists of the West, his collections being preserved in several museums. Between 1920 and 1923 he served as director and as curator of vertebrates on the staff of the San Diego Natural History Museum."

SCIENTIFIC NOTES AND NEWS

THE autumn meeting of the National Academy of Sciences will be held at Brown University on October 23, 24 and 25. The address of welcome will be made by Dr. Henry Merritt Wriston, president of the university, and the response will be made by Dr. Frank B. Jewett, president of the Bell Telephone Laboratories, who was elected president of the academy at the spring meeting. Members of the committee on arrangements are: W. S. Hunter, *chairman*, P. H. Mitchell, R. B. Lindsay, C. A. Kraus, R. G. D. Richardson, W. H. Snell and F. E. Wright (*ex-officio*).

AT the commencement exercises of the Case School of Applied Science the doctorate of science was conferred on Dr. Clement C. Williams, president of Lehigh University, formerly dean of engineering at the University of Iowa, who gave the principal address, and on Dr. Otto Struve, director of the Yerkes and McDonald Observatories. The doctorate of engineering was conferred on M. Y. Seaton, chief engineer of the California Chemical Corporation.

DR. W. G. CROCKETT, professor of pharmacy at the Medical College of Virginia, was awarded the honorary degree of doctor of science by Hampden-Sydney College at the final exercises of that institution on June 6.

Dr. Thomas S. Roberts, professor of ornithology and director of the Museum of Natural History of the University of Minnesota, has been awarded the Brewster Medal by the American Ornithological Union "for the most meritorious work on American birds." The medal was presented to Dr. Roberts in Washington, D. C., for the second edition of his "The Birds of Minnesota."

The council of the Royal Society of Tropical Medicine and Hygiene at its last meeting awarded the Chalmers Gold Medal for 1939 to Dr. Max Theiler, of the International Health Division of the Rockefeller Foundation, New York, "in recognition of research of outstanding merit contributing to the knowledge of tropical medicine or tropical hygiene, particularly in reference to yellow fever and the possibility of producing the vaccine by the use of attenuated virus." The medal will be presented at the annual general meeting of the society at Manson House, London, on June 15.

The following were elected honorary fellows of the Royal Society of Medicine on May 16: *British Honorary Fellows:* Professor William Bulloch and Sir Cuthbert Wallace. *Foreign Honorary Fellows:* Dr. Alexis Carrel, New York; Professor C. G. Jung, Zurich; Professor Charles Laubry, Paris; Dr. Max Neuburger, Vienna, and Professor J. Schoemaker, The Hague.

The Anna Fuller Memorial Prize of $7,500 for cancer research has been awarded for the first time to a group of five scientific men of the Research Institute of the Royal Cancer Hospital, London. It will be shared equally by Ernest Laurence Kennaway, director of the institute; James Wilfrid Cook, Colin Leslie Hewett and Izrael Hieger, chemists; and William Valentine Mayneord, physicist. The award is made upon the recommendation of the president of the American Medical Association, Dr. Irvin Abell; the dean of the Johns Hopkins Medical School, Dr. Alan M. Chesney; and the dean of the Harvard Medical School, Dr. C. Sidney Burwell.

Professors J. P. Moore and P. P. Calvert, of the department of zoology of the University of Pennsylvania, will retire at the end of the present academic year. On the evening of May 31, their present and former students and associates held a dinner in their honor at the Hotel Normandie, in Philadelphia. Dr. Josiah H. Penniman, who retires this month as provost of the university, presided, and Dr. Edwin G. Conklin, executive vice-president of the American Philosophical Society, gave the principal address. More than a hundred guests were in attendance. Professor Moore was presented with a microscope and Professor Calvert with special equipment for his microscope. A large portrait photograph of each, suitably framed, was presented to the university to be hung in the Zoological Laboratory.

Dr. Wortley F. Rudd, dean of the school of pharmacy of the Medical College of Virginia, was made president-elect of the Virginia Academy of Science at its annual meeting, which was held in Danville from May 4 to 6.

At the annual meeting of the American Society of Clinical Pathologists in St. Louis on May 12 Dr. L. W. Larson, Bismarck, N. D., was inducted into the office of president for the coming year. Officers were elected as follows: *President-elect,* Dr. A. V. St. George, New York; *Vice-president,* Dr. C. L. Klenk, St. Louis; *Secretary-treasurer,* Dr. A. S. Giordano, South Bend, Ind.; members of the *Executive Committee,* Dr. T. B. Magath, Rochester, Minn., and Dr. F. W. Konzelmann, Philadelphia; of the *Board of Censors,* Dr. F. B. Queen, Chicago, and Dr. W. R. Mathews, Shreveport, La.; and of the *Board of Registry,* Dr. A. H. Braden, Houston, Texas, and Dr. J. B. McNaught, San Francisco, Calif. The Ward Burdick award was presented to Dr. Harry Goldblatt, Cleveland, for his work on Arterial Hypertension; the scroll for meritorious service was awarded to Dr. Philip Hillkowitz, of Denver, and the Gold Medal for excellence in the scientific exhibit was awarded to Drs. S. E. Ziffren, C. A. Owen, G. R. Hoffman and H. P. Smith, of Iowa City.

Dr. James Marshall Hanna Rowland, dean of the Medical School of the University of Maryland for the past twenty-four years, will retire with the title dean emeritus at the close of the present academic year.

Dr. Emil Peter Sandsten, director of the Agricultural Experiment Station and dean of agriculture of Colorado State College at Fort Collins, will retire with the title of emeritus on July 1. Dr. Sandsten will be succeeded by Dr. Charles H. Kick.

Dr. Otto Dunkel, of the department of mathematics and astronomy of Washington University, St. Louis, will retire this June after having served as a member of the faculty for twenty-three years.

Antoine M. Gaudin, research professor of mineral dressing at the Montana School of Mines at Butte, an authority on process metallurgy, has been appointed Richards professor of mineral dressing at the Massachusetts Institute of Technology.

Dr. Donald H. Menzel, associate professor of astrophysics at Harvard University, has been promoted to a professorship.

Carl-G. A. Rossby, head of the department of meteorology of the Massachusetts Institute of Technology, has been appointed to the newly established position of assistant chief for research and education in the U. S. Weather Bureau. He has leave of absence from the institute for three years.

Dr. A. A. Blair, who has been assistant fishery biologist at the Solomon's Island Marine Biological Laboratory, Maryland, has resigned to accept a post with the Government of Newfoundland, where he will take charge of fishery investigations.

The Committee on Scientific Research of the American Medical Association has made a grant to Dr. Warren O. Nelson, professor of anatomy at Wayne University, for the continuation of studies on the thymus gland. The present grant extends the assistance which the committee has given during the past eighteen months.

Dr. Henry E. Sigerist, professor of the history of medicine at the Johns Hopkins School of Medicine, sailed on May 30 for Europe and will later go to South Africa. He expects to return to Baltimore early in December. While in Europe Dr. Sigerist will attend an international conference on socialized medicine from June 23 to 25 at Liège, Belgium. In South Africa, from August until the middle of November, he will deliver a course of twenty-five lectures in each of ten institutions.

Dr. E. A. Rovenstine, professor of anesthesia at the New York University College of Medicine and director of the Division of Anesthesia at Bellevue Hospital, sailed on June 1 for South America. He will present a series of demonstrations and lectures on anesthesia to medical schools in Santiago and Concepcion, Chile, and in Buenos Aires and Rosario, Argentina. He expects to return late in July.

David Lack, leader of the Lack-Venables Expedition to the Galapagos Islands under the auspices of the Royal and London Zoological Societies, has arrived in San Francisco with thirty living specimens belonging to four species of endemic Galapagos finches. The original plan was to take these birds to London for experimental breeding studies. Having reached Panama, however, with the birds in only fair condition, Mr. Lack feared that they would not survive the trip to England. Accordingly, with the approval of Dr. Julian Huxley, arrangements were made by cable to transfer the whole problem to the California Academy of Sciences, where the breeding experiments will be conducted by Dr. Robert T. Orr, assistant curator of birds and mammals.

Professor Aubrey J. Kempner, on the recommendation of the Council on Research of the University of Colorado, gave the annual research lecture on May 15. He spoke on "What is the Nature of Mathematics, and in what Sense does Mathematics Explain a Science?" The lecture was given in Boulder, the fourth in the series of annual lectures established to honor research workers and give public recognition to the research activities of faculty members.

Dr. Otis W. Caldwell, general secretary of the American Association for the Advancement of Science, gave the commencement address at the Medical College of Virginia, Richmond.

Dr. Oscar Riddle, of the research staff of the Station for Experimental Evolution of the Carnegie Institution at Cold Spring Harbor, N. Y., gave an address on May 8 before the Mayo Foundation, Rochester, Minn., on "Some Products and Performances of the Anterior Pituitary Gland."

The last week of June at Stanford University will be devoted to meetings of the Pacific Division of the American Association for the Advancement of Science, including on Friday afternoon a symposium on x-rays and molecular structure. The Centenary Symposium on the Cell and Protoplasm is from June 30 to July 5. The last day, with addresses by O. L. Sponsler, L. V. Heilbrunn and J. D. Bernal, and a garden party at the home of Professor and Mrs. McBain, leads up to the National Colloid Symposium, which meets from July 6 to 8 with a program of twenty-eight papers. The guest of honor is J. D. Bernal, F.R.S., of the University of London.

The University of Wisconsin Medical School will conduct an Institute for the Consideration of the Blood and Blood-Forming Organs from September 4 to 6. The program will include papers and round-table discussions by European and American workers in the field of hematology. In addition to the discussions a program of formal papers will be presented. The speakers will include: Dr. L. J. Witts, Oxford, England; Dr. Cecil J. Watson, Minneapolis; Dr. Cornelius P. Rhoads, New York; Dr. E. Meulengracht, Copenhagen, Denmark; Dr. Harry Eagle, Baltimore; Dr. George R. Minot, Boston; Dr. Russell L. Haden, Cleveland; Dr. Jacob Furth, New York; Dr. Claude E. Forkner, New York; Dr. Edward B. Krumbhaar, Philadelphia; Dr. Louis K. Diamond, Boston; Dr. Edwin E. Osgood, Portland; Dr. Charles A. Doan, Columbus; Professor Hal Downey, Minneapolis, and Dr. Paul Reznikoff, New York. A detailed program may be obtained by addressing Dr. Ovid O. Meyer, chairman of the Program Committee, University of Wisconsin Medical School, Madison, Wis.

A group of courses will be given during the summer session of the University of Pittsburgh from July 6 to August 1 on the "Physics of Metals." An attempt will be made to understand the nature of the forces which make pure metals and alloys hard or soft, ductile or brittle, good or bad conductors of electricity, etc. Courses will be offered by Dr. John C. Slater, head of the department of physics, the Massachusetts Institute of Technology; Dr. M. F. Manning, University of Pittsburgh; Dr. William Shockley, the Bell Telephone Laboratories; Dr. Frederick Seitz, University of Pennsylvania; Dr. Edward U. Condon, associate director, the Westinghouse Research Laboratory. A booklet describing these courses has been prepared, and may be obtained by writing to Professor E. Hutchisson, University of Pittsburgh.

SIGMA PI SIGMA, physics honor society, installed a new chapter at Wayne University, Detroit, on May 22. Dr. F. C. Blake, of the Ohio State University, national president; Dr. M. W. White, of the Pennsylvania State College, national executive secretary; and Dr. C. W. Chapman, of the Michigan State College, were the installing officers. Following the installation banquet an open meeting was held, which was addressed by Dr. P. E. Klopsteg, of the Central Scientific Company, Chicago, who spoke on "Scientific Aspects of Archery."

CORNELL UNIVERSITY announces the establishment at Ithaca of a Summer Research Station in Psychology. Beginning this summer, facilities will be available, without fees, for experimental research, library research and informal study, to investigators holding the doctor's degree. Information concerning laboratory facilities and living accommodations may be obtained from the Secretary of the Department of Psychology, Cornell University, Ithaca, N. Y.

THE University of Missouri has received a grant of $80,000 for the erection of a building for the Laboratory of Genetics from the Division of Natural Sciences of the Rockefeller Foundation and an additional grant of $20,000 for the continuation of research projects now being carried on by Dr. L. J. Stadler, professor of field crops, and Dr. Barbara McClintock, assistant professor of botany, and their associates. Their work has hitherto been supported by the Rockefeller Foundation, the Missouri Agricultural Experiment Station, the U. S. Department of Agriculture and from general university funds.

THE National Foundation for Infantile Paralysis has approved a grant of $161,350 for the establishment of an infantile paralysis center for Negroes at the Tuskegee Institute, Alabama. The money will be used to build, equip and maintain for one year a center of thirty-six beds. The construction of the building will be started without delay.

DR. STUART T. DANFORTH, formerly a professor at the College of Agriculture at Puerto Rico, has bequeathed to the Smithsonian Institution one of the most complete collections yet made of birds of the West Indies. It consists of more than 3,000 specimens. Dr. Danforth spent approximately thirteen years in gathering this collection, which contains not only all the common forms of the islands, but some of which there are only a few specimens in existence.

THE Institute for Advanced Study at Princeton has been declared exempt from taxation by the State Board of Tax Appeals. The property on which the institution is located was assessed for $9,625 in 1937 and the Mercer County Tax Board denied a claim to exemption from taxation. The institute appealed to the state board to reverse the decision. In rendering this decision the state board pointed out that the institution makes no charge to students and, in some instances, subsidizes competent persons otherwise unable to take advantage of its resources, and that the property is used exclusively for non-profit-making, educational purposes.

DISCUSSION

MICRO-COPEPODA IN MARINE PHYTOPLANKTON CATCHES[1]

IN 1938 the Scripps Institution of Oceanography made six cruises (February, April, June, August, October and December) off the coasts of California in pursuit of hydrographical, chemical and biological investigations. Thirty-one stations were worked on each cruise except for minor changes and except for omission of about half in April on account of bad weather. On each cruise five liter samples of water for phytoplankton researches were collected with the Allen closing bottle and filtered through the Allen filtration net of No. 25 mill silk bolting cloth. Except for Cruise II (six levels only) collections were made at seven levels at each station (surface, 10, 20, 30, 40, 50, 60 meters).

While making routine microscopical studies of the phytoplankton I was struck by the constancy of representation of copepods less than two millimeters in length (most less than one millimeter). One female carrying twenty-five eggs was .85 mm long and one carrying fifteen eggs was .76 mm. Some of the nauplii were only about .15 mm long; surpassed in dimensions by a few of the diatoms and dinoflagellates with which they were associated.

By the time that I had studied about a thousand catches I got the idea that this copepod population deserved some special notice. Using my Sedgwick-Rafter counting cell I enumerated the micro-copepoda in one tenth of each catch and calculated the numbers per catch for the seven stations on the northern line of cruising, which extended 140 miles to sea from the general vicinity of San Luis Obispo. Separate records were kept of numbers in naupliar and copepodid (post-naupliar) stages.

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[1] Contribution from the Scripps Institution of Oceanography, New Series, No. 56.

A very few individual catches showed no specimens in the fraction counted, but no station showed less than 310, and two exceeded 1,000 per station. In numbers per cubic meter the range would be from about 10,000 to 30,000, a population far from negligible, especially when the constancy of representation is considered, both seasonal and geographical. The largest individual catch from any of the seven stations (134,000 per cubic meter) was made at a depth of thirty meters about seventy-five miles offshore. In most catches the numbers of nauplii were slightly larger than the aggregates of post-nauplii stages.

The tendency to show greatest abundance at or near a depth of thirty meters was very distinct in all cruises, possibly with some relationship to time of day and night, although the time correlation does not appear clear to me. That level was in the lead at four of the seven stations, and it was second at two. Twenty meters and forty meters were somewhat alike. The three levels were within the leading three in fourteen out of twenty-one instances. Contrariwise, the surface and sixty-meter levels were *not* within the leading three at any station.

No clearly marked seasonal differences were observed, although June seemed to be a little the best.

Locality differences were fairly notable, though not so prominent as the differences of levels. The station nearest shore (about nine miles) did not appear most prominent at any depth. On the other hand, the seventy-five-mile station was highly prominent at different depths, no other station showing so well. A few random counts at stations in other lines followed on the cruises indicated that micro-copepoda were regularly represented by considerable populations even at stations nearly two hundred miles from shore, *i.e.*, in waters clearly oceanic in character.

The largest single catch of micro-copepoda was taken with a large catch of diatoms at thirty meters at the seventy-five-mile station. One or two others of the larger catches also gave the impression of a tendency to larger numbers in catches containing notable numbers of diatoms. Superficially, one may be tempted to link such observations with the view commonly expressed by marine biologists that copepods feed heavily on diatoms. Unfortunately for this linkage, the micro-copepoda seem to be too small to feed successfully on the diatoms. For example, in this largest catch most of the diatoms (a large form of *Rhizosolenia styliformis* Btw.) were larger than the nauplii and as long as most of the copepodids.

Even more noticeable than the presence of the micro-copepoda was that of debris or detritus in all catches. In some catches two hundred miles from shore the volume of inert material appeared far greater than the combined volumes of diatoms, dinoflagellates and other micro-plankton. Variable proportions of these inert particles were organic in aspect at different times at different stations, but there was enough constancy of representation of organic material to suggest the idea that the micro-copepoda may depend upon it largely for sustenance; directly by ingestion, indirectly by feeding on bacteria or other organisms associated with the particles. Of course, this does not mean that association with the diatoms does not help the small copepods. It is entirely possible that they need the oxygen liberated by the latter and that the diatoms are benefited by the opportunity to use their wastes.

On account of my commitment to investigations of phytoplankton populations I shall not be able to give any more attention to these fascinating problems of the micro-copepoda. I am offering this memorandum because no quantitative study of marine micro-copepoda at seven specific levels, at all seasons of a single year, in a series of stations extending from littoral into oceanic waters has ever been made before. It is intended merely to give direct evidence of the existence of an important animal population which can be studied to advantage by methods similar to those used for phytoplankton at the Scripps Institution of Oceanography. It is possible that these populations of very small animals constitute an important feature in the supply of foods for young fishes and other prominent marine animals.

W. E. ALLEN

SCRIPPS INSTITUTION OF OCEANOGRAPHY,
UNIVERSITY OF CALIFORNIA

MARSH GAS IN THE ECOLOGY OF SOME PEAT-BOGS

THE peat-bogs or muskegs of the north have been of great interest to plant ecologists and botanists from the highly specialized character of the flora and the peculiarly severe conditions which the plants must endure to survive. There are few habitats which offer more unfavorable conditions in many respects or such a wide range of extremes as these areas, oftentimes very small, afford. Investigations have shown that the pH values of the sphagnum water itself may be as low as 4.5 and that of the carex bog 7 or near this figure, while the open water in places may show a pH of 9. Many other conditions may obtain here which the majority of our mesic plants are unable to tolerate, including stagnancy and lack of aeration or oxygenation, oftentimes low temperatures due to a permanent frozen substratum a few feet below the bog, lack of sufficient nitrification and low available nitrogen supplies, possibly the presence of organic toxins.

Whatever the synthesis of conditions may be, it is obvious that we have here a habitat and an environmental complex which is highly selective for certain types of flora, among which *Sphagnum*, *Ericaceae*, carices and other sedges and certain conifers are prominent at one place or another depending upon local conditions, successional stages, etc.

The writer in his youth spent much time observing a small natural bog and pond known as Grassy Pond, Oxford, Massachusetts, the origin of which of course was associated with the last retreat of the Pleistocene ice sheet. A deep basin had been created in the hills, in part here, by a superb esker which had dammed the drainage on the east perhaps 40,000 to 50,000 years ago, if the geological clock is correct. At any rate it was obvious enough that a much larger pond had existed here in the beginning, but it had at last reached the old age stage of its history, represented now mainly by a peat bog with *Sphagnum* in places, quaking bogs, sedges, heaths and with only a small area of free water remaining. There was black, oozy, organic mud everywhere.

It was evident that plant life had been mainly responsible for this profound reclamation. In every respect it is typical of thousands of bogs or muskegs scattered over New England and Canada, but around Grassy Pond there was no trace of living black spruce or of other conifers so characteristic of the more northern coniferous area.

In summer the writer found much interest in traveling barefoot through this bog, to observe the various plants and birds dwelling here, for such plants as *Pogonia ophioglossoides*, *Calopogon* and *Arethusa* made a colorful flower garden of the area. Traveling here became precarious in places, for the tenacious sedge carpet moved with undulations as one walked along over the soft black ooze, causing the sustaining mat of interlacing roots to sink 8 to 10 inches into the water. In July and August the mat sinking beneath one's footsteps caused a copious rush of big bubbles of gas to the surface. Many times the writer amused himself collecting two quart pailfuls of this gas by holding the pail inverted over the up-rushing bubbles as he walked along, after it had been so manipulated as to become filled with water. When the pail was full of the lighter gas, which was methane or marsh gas, CH_4, he fired it with a match to observe the explosive puff which followed. Great quantities of this marsh gas, it seems, reposed beneath these tough rootlayers of the sedge mat as a zone of bubbles which could not well escape until trampled upon so that they were forced through the organic ooze and interlacing roots. Peculiar conditions prevailed here, for the thin layer of water over the sedge mat was extremely warm due to the absorption of heat from the sun's rays, while to the bare foot the water and ooze below the root zone remained very cool.

It is now relevant to inquire as to what effect if any this marsh gas may have upon the growth of the plants in this peculiar habitat. Is it an additional unfavorable factor with direct more or less toxic effects to which these bog plants must adjust themselves, since it is soluble in water to the extent of 3.3 per cent. by volume at 68° F.? Whether or not it exerts toxic effects, indirectly this gas can not but prove to be an unfavorable factor to some plants, since its presence in abundance in the root zone must greatly dilute the air and the free oxygen supplies leading to conditions of oxygen starvation which many plants of the higher lands seemingly can not tolerate, as is well known.

A striking feature of these methane areas, however, is the abundance of the sedges and the other vegetation naturally colonized here and apparently thriving.

A very extensive literature has developed dealing with the effects of various types of illuminating gas on plants, but as yet no general agreement has been reached as to just what specific components are responsible for the injuries, death or other effects observed. It is well established that these gases in the soil and in the air, under certain conditions may prove very harmful to large trees, shrubs or herbaceous plants.

The coke-oven type of illuminating gas with which some of the work has been done contains a variety of constituents in considerable amounts, including hydrogen as high as 50 per cent., methane 25 per cent., carbon monoxide 8 per cent., nitrogen 10 per cent., naphthalene 3.5 per cent., besides small amounts of carbon dioxide, oxygen, illuminants, etc. A number of these components are unquestionably very harmful to plants in one way or another, and the deleterious effects produced represent a resultant of many factors, making it impossible to decide which unfavorable factors were responsible and to what degree.

Natural gas is extremely rich in methane, running as high as 75 per cent. to 100 per cent., with only very small amounts of some of those constituents which may be present and very injurious in the manufactured coke-oven types.

The gas of the Grassy Pond bog probably closely approaches this type, a nearly pure methane gas, since it was practically odorless, indicating that hydrogen sulfide was not present.

It is well known that the bog methane is due to bacterial decomposition mainly of cellulose vegetable matter under anaerobic conditions. The gas of the activated sludge process of sewage disposal may also contain 80 per cent. or more of methane.

Recent studies of chemists have aimed to find methods of converting farm wastes such as corn stalks, etc., into a fuel gas, and processes have been proposed which will produce a gas with about 50 per cent. of methane. These results are significant, since methane is exceedingly valuable as a beginning step in the production of hydrogen, ammonia, . . . (NH_3), etc.

Since methane gas, through the increasing use of natural gas and proposed conversion of farm waste, may in the future play a more important part in life, it is well to know all its ecological properties both in nature and in the laboratory.

Methane, it would appear, is a strikingly inactive gas chemically and physiologically, and it is said it can be breathed in concentrations up to 45 to 50 per cent. of the air volume, with no particularly noticeable ill effects aside from a lowering of the oxygen content. It is the active element of the dreaded "fire damp" of coal mines.

The plant life of the Grassy Pond bog would seem to substantiate this inactive physiological behavior, and to the heaths (*Ericaceae*), sedges and other vegetation of these habitats it is perhaps as inert in itself as the free nitrogen which is the necessary diluent component of our atmosphere.

To say the least, marsh gas may be an important environmental factor in some peat bog areas, and under certain conditions may help to create a low oxygen atmosphere in the water and air surrounding the roots of a group of normal associes of these areas, which are highly tolerant of such conditions.

H. A. ALLARD

U. S. DEPARTMENT OF AGRICULTURE

PATENTS FOR CHEMICAL COMPOUNDS

DR. CHARLES E. RUBY has recently criticized[1] the policy of the United States Patent Office and Courts for granting and sustaining patents for new and useful chemical compounds. He affirms that such chemical compounds are not human creations but are entirely acts of nature. In this he is entirely incorrect. Although many chemical compounds are found naturally occurring, the synthetic methods of chemistry enable many very useful pure substances to be produced that are not found in nature. The conception and eventual construction of new and useful chemical compounds are accomplished only and entirely through the application of human mental and physical activity. This most certainly constitutes invention, for invention can not consist of more or less than the adjustment of nature to human use and needs.

New and useful chemical compounds should be and are classified together with new plants and new machines. A new printing press could, in a certain sense, be called an act of nature; for is not its operation and construction down to the minutest detail governed by the laws of nature? What fundamental difference is there between the concept of a new chemical compound and the invention and construction of it by means of chemical reactions and the concept of a new machine and the invention and construction of it by means of mechanical operations? A new chemical compound is no more made available for human use by nature than is an automobile. If a new engine is invented, a patent may be issued on the engine and not upon the use of lathe and drill press in its construction. Similarly, if a new chemical compound is invented (and it is without question at least as much of an invention as the engine in that it requires as much human ingenuity to conceive and produce it) a patent is and should be issued on the compound and not on the reactions used in its production.

If our patent laws are changed so that new and useful chemical compounds are not given the benefit of patent protection, a considerable amount of chemical research will be immediately stopped and society will lose the benefits of both the research and the new compounds. Restricting the patent protection to the method of production of the compound will not give enough protection to warrant the expense of the research, because once the usefulness of a new compound is shown many methods of producing it can be found.

There is only one minor difference between the construction of a new compound and a machine. The one is accomplished through processes and the other operations; but basically they are the same, as the fundamental laws of mechanics and electricity govern both methods of procedure. From a patent point of view, the birth of the idea, the initial construction, the development and the testing of the results follow the same pattern in both cases.

Our great mechanical improvements of the past were greatly stimulated by patent protection. Let us not now retard our present age of chemical development by withdrawing patent protection.

J. H. SIMONS

THE PENNSYLVANIA STATE COLLEGE

THE CONFIGURATION OF GLUTAMIC ACID FROM SCARLET FEVER ANTITOXIN

AFTER reading the remarkable paper by Kögl and Erxleben[1] in which they showed that the glutamic acid, and to a lesser extent some other amino acids of tumor proteins, were partly of the wrong configuration, it occurred to the writer that it would be of interest to know whether the glutamic acid of an antitoxin is also partially racemized. If this were the case it would help to explain the great resistance of certain antitoxins toward cleavage by proteolytic enzymes.

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[1] SCIENCE, 89: 387, 1939.

[1] F. Kögl and H. Erxleben, *Zeit. Physiol. Chemie*, 258: 57, 1939.

Accordingly, a sample of refined and concentrated scarlet fever antitoxin[2] containing three grams of protein was hydrolyzed by hydrochloric acid and the glutamic acid isolated by Foreman's barium salt method. After four recrystallizations the glutamic acid hydrochloride melted at 203° C. and gave the following analysis:

Found: C, 32.82%; H, 5.48%; N, 7.66%
Calculated for $C_5H_{10}O_4NCl$: C, 32.69%; H, 5.49%; N, 7.63%

The specific rotation in 9 per cent. hydrochloric acid was $[\alpha]_D^{27°} = +32.2°$ when calculated as the free acid (49.5 mg in 3.06 cc gave a rotation of +0.42° in a one dm. tube). This value is in good agreement with that of d-glutamic acid, +31.5°.

It is therefore apparent that at least the glutamic acid of scarlet fever antitoxin is of the normal configuration. Whether this situation extends to other amino acids and other antitoxins remains to be seen.

ROBERT D. COGHILL

YALE UNIVERSITY

LUCITE

IN my recent paper, "'Lucite' for microscopic Trans-illumination," published in SCIENCE, Volume 89, No. 2312, April 21, 1939, I made the following statement: "This is presumably the first report of the use of Lucite for this purpose and as a substitute for the Abbe Condenser."

Dr. Elbert C. Cole, of Williams College, has kindly called my attention to the fact that a paper written by him in SCIENCE in April, 1938, entitled "Methyl Methocrylate as a Laboratory Tool," suggested the use of this substance for illuminating living tissue for observation with the microscope. I gladly give Dr. Cole priority as to the use of this substance for illumination.

LEE S. FENT

SCIENTIFIC BOOKS

A HISTORY OF SCIENCE

A History of Science, Technology and Philosophy in the 18th Century. By A. WOLF, professor of the history of science in the University of London. 814 pp., with 345 illustrations. The Macmillan Company, New York, 1939. $8.00.

IT is probably universally true that every reviewer wishes to criticize a book within his own field of interest, and particularly from his own point of view. But, in the case of the volume before us, Wolf's "History of Science, Technology and Philosophy," a reviewer must necessarily take a four-dimensional point of view in order to encompass all that is printed within its 814 pages. The thirty-two chapter headings, beginning with eighteenth century mathematics and ending with philosophy, have called forth all that is implied in pure science and technology, including agriculture, scientific instruments, building, transportation, metallurgy, telegraphy, psychology, medicine, economics, social science, geography and philosophy. This wide range of subject-matter is new from the standpoint of the purely academic treatment of the history of science; it should require, therefore, a group of reviewers or encyclopedists to evaluate properly the true merit of this book.

This volume is the second of a series planned by Professor Wolf, and is of the same general character and scholarship as the first book, which was critically reviewed in SCIENCE.[1] The main points of criticism which Dr. Sigerist brought out in this review concerning the treatment of the history of science in the sixteenth and seventeenth centuries are still valid in the volume for the eighteenth century. There is the same lack of coordination and continuity of subject-matter, and there is no critical analysis of the theory, work and philosophy of each scholar, inventor and philosopher. According to Professor Wolf's treatment in the historical method, each field of activity has gone its own appointed way without apparent reference to the basic sciences.

Modern science has its heritage, and a rich one, from the past. Each succeeding age or century shows something of a mathematical progression in its accomplishments. Accordingly the sixteenth and seventeenth centuries were treated in one volume, while the eighteenth century alone required one volume with one hundred pages more for its treatment. The eighteenth century was a critical one in that scientific discoveries, based upon fundamental principles and natural laws, were asserting themselves in the form of practical application to the needs of society and the betterment of man. Professor Wolf has shown that advances were made in almost every field of intellectual enterprise and that there was an unprecedented spread of knowledge beyond the circle of the specialists. He has by comparison shown that the age of enlightenment was a worthy heir to the age of genius. But he has treated upon this only in the form of chapters on independent subjects, and not as a continuous history of ideas, movements or results. The task of bringing order into the apparent tangle of luxuriant growth of scientific and technological advances is almost an impossible one, but Professor Wolf has succeeded to a large degree in setting forth what is known. There is nothing particularly new in what the author has written; he has gathered his material from a rich source of original work of the great pioneers in each field.

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[2] Kindly furnished by Parke, Davis and Company.

[1] SCIENCE, 83: 2150, 262–264, March 13, 1936.

The cultural aspect of science upon society should have been continually emphasized. One of the best examples of the influence of an institution upon an epoch was that of the Royal Society of London upon the life and thought of the colonial period of American history and culture. We find a good account of the experiments of Franklin with electricity in 1746 and succeeding years. These were the great pioneer days of research in static electricity, and Wolf has treated carefully of Franklin's influence on the principal workers in this field. However, as well as commenting upon Franklin fully and deservedly, the author should have included a better treatment of the work of other Colonial scholars such as Cotton Mather, Paul Dudley, James Logan and John Bartram, who did pioneer experimentation on plant breeding, and Zabdiel Boylston, who was famous for being the first in the Colonies to inoculate for smallpox. The Royal Society recognized these men and approximately fifteen other colonial scholars during the eighteenth century of colonial America, by electing them as fellows.

A true history of science can be written by covering one field by epochs, but not by encompassing the whole range of human thought and invention. The history of art, science or philosophy should be treated in the form of a great symphony in which interrelations are shown in movements, where each great crescendo seems to be the result of a gradual upbuilding of ideas, feelings and moods, all influencing the human soul in its constant struggle for greater self-expression and life. A historian can be a Beethoven, a Mozart or a Wagner.

However, as stated in the beginning, the reviewer takes the liberty of judging this book from an unusual point of view, that of a librarian or bibliographer. The constant demand upon this profession for appraisal of the worth of a book and its service to readers encourages the bibliographer or reference librarian to become specialized in some field of research. The librarian of to-day, in this country, is becoming more and more conscious of scholarship. He is aware of his superior modern library technique and is now seeking the cultural aspects of his profession. Standard reference or source books are the essential tools of the reference librarian, and to this class Professor Wolf's book belongs in large measure. What has been set forth in each chapter and sub-chapter is clearly and concisely stated, sufficiently so that if further details are required the reader is referred to the original source. Also, for the bibliographer who wishes to prepare a select or critical bibliography of original source references and biographies of the great scientists of the past, the material is readily available. Professor Wolf has used good judgment in his selection.

The index, in its treatment by author and subject, leaves much to be desired. In cases of more than three references to a scholar it should have been more descriptive or analytical. The table of contents does not aid us here, in spite of the fact that it is well prepared from another point of view. This is a disconcerting phase for the reference librarian. In seeking to ascertain the work of any scholar, as for example, Newton, Euler, D'Alembert, etc., one does not find complete reference to his accomplishments. For example, in the chapter on light, which is comprehensive for general reference, mention is made of Euler and his work on light, leaving us not quite certain that this was all he did. The index does not show his profound discoveries in mathematics and physics, but gives only a large number of blank page references which makes it difficult to find record of his work in other fields.

The format is good, the book being well printed on durable light paper, which was necessary in order to handle a volume of 814 pages conveniently. The illustrations and line drawings are carefully selected and printed, and the numerous portraits lend dignity and beauty to the volume, since they were printed on paper especially adapted for such work. Professor Wolf has placed before the librarian and general scholar a decidedly useful compendium of scientific, technical and philosophical knowledge of the eighteenth century, which should be on every reference shelf, private or public.

FREDERICK E. BRASCH

LIBRARY OF CONGRESS

BIRDS AND THE SPECIES PROBLEM

A Systematic Review of the genus Phylloscopus (Willow-Warblers or Leaf-Warblers). By CLAUD B. TICEHURST. British Museum (Natural History), 1935. Pp. 193. Two colored plates.

At first sight it might well appear that a revision of a genus of Old World Warblers (*Sylviidae*) would be of little interest to American naturalists, but I should like to recommend Dr. Ticehurst's book for supplementary reading in all biological laboratories. The method of presentation is so interesting and so adequate, that we seem to have revealed to us the very course of events by which new races and species arise. The work is based on the examination of about nine thousand specimens, and much field work. Under each species we have details concerning the breeding range, and also the winter range, reached by migratory movements. The characters cited are divided into two groups, those which may be studied in the museum, and those which may be observed in the field. The latter include peculiarities of voice or song, which are often strongly characteristic of birds which would be hard to distinguish in life by vision alone. There are recognized thirty species, but these are increased to sixty-seven if we count all the subspecies. What is a subspecies? It is a recognizably distinct population which in some part of its range intergrades with one or more allied populations, all together constituting the species. Such subspecies, regarded objectively, may in certain cases owe their characters to the direct effects of a special environment. These have no proper genetic basis, and are not equivalent to true subspecies as recognized in taxonomy. But it is clearly brought out by modern research that genuine subspecies may have two different sorts of origin; they may arise by gradual differentiation from a parent stock, or they may be due to the crossing of two distinct types, which would otherwise be regarded as good species. In the one case, the subspecies represents a stage in the origin of species; in the other, it represents the breaking down of specific characters which have developed in isolation. Thus, for instance, Ernst Mayr in a paper just published, on the Birds of New Guinea, points out that *Megapodius affinis* and *eremita* are very distinct, but on Dampier Island they meet and freely cross, no physiological barrier having arisen to prevent it. Hence they must be treated as a single species. Ticehurst, in his treatment of subspecies of warblers, shows that a very curious condition may arise. He finds that two subspecies may develop from a common species, and spreading outward become increasingly distinct. At length, they may happen to invade each other's territory, and when so doing, may behave as perfectly distinct species, keeping distinct from one another. This happens in the case of the forms of *Phylloscopus trochiloides*, as is explained in detail, with a map. A very interesting case is that of *Phylloscopus borealis kennicotti* (Baird, 1869), the only member of the genus which reaches North America. It has evidently come over from Asia, and while it breeds in Alaska, it still migrates southward in the winter along the coast of Asia, and not at all along our Pacific Coast. The migration route is thus older and more persistent than the subspecies.

Another noteworthy fact is that whereas a species may go far south in migration, and thus have an immense range, it may nevertheless throw off satellites, if one may so call them, which become permanent residents somewhere along the path of migration. Thus *Phylloscopus collybita canariensis* is a permanent resident in the western group of the Canary Islands, while *P. c. exul* occurs only on Lanzarote, in the same archipelago. These cases recall some on the islands off the west coast of North America. *Regulus calendula obscurus* (also one of the Sylviidae) occupies Guadalupe Island; while the humming-bird, *Selasphorus alleni sedentarius*, instead of migrating to Mexico, is a permanent resident on Santa Catalina, San Clemente and Santa Cruz Islands.

T. D. A. COCKERELL

UNIVERSITY OF COLORADO,
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SOCIETIES AND MEETINGS

THE VIRGINIA ACADEMY OF SCIENCE

THE Virginia Academy of Science held its seventeenth annual meeting in Danville on May 4, 5 and 6 with weather conditions favorable for its two field trips, one in biology and one in geology. There was much interest in a new section on engineering, which presented a program of 16 papers.

The finance committee brought in an encouraging report, and so two new lines of work were undertaken by authorizing the incoming president to appoint (1) a committee to encourage the formation and foster the development of science clubs in the high schools of the state, (2) a committee to establish an official academy publication which will probably be known as the *Virginia Journal of Science*. The academy also referred to its conservation committee for especial consideration the problem of the conservation and preservation of the Dismal Swamp.

The academy prize of $50.00 was awarded to M. J. Murray and Forrest F. Cleveland, of Lynchburg College, for a paper entitled, "The Use of Polaroid in Depolarization Measurements on Raman Lines," and the Jefferson Gold Medal was awarded to G. M. Shear and H. D. Ussery, of the Virginia Polytechnic Institute, for a paper entitled, "Frenching of Tobacco Distinguished from Thallium Toxicity by Spectrographic Analysis."

In the sectional meetings Astronomy, Mathematics and Physics presented 20 papers; Biology 13; Botany 7; Zoology 10; Chemistry 26; Education 12; Engineering 16; Geology 18; Medicine 9; and Psychology 7, making a total of 138 besides a symposium on "Organic Analytical Reagents" and a round table on "The Problems of Applied Psychology."

The following officers were elected: Ruskin S. Freer, of Lynchburg College, *President;* Wortley F. Rudd, of the Medical College of Virginia, *President-elect;* E. C. L. Miller, of the Medical College of Virginia, *Secre-*

tary-Treasurer; and I. A. Updike, of Randolph-Macon College, *Assistant Secretary.* New members of the council are: C. E. Myers, of the State Board of Education; Preston Edwards, of Sweet Briar College; and Marcellus H. Stow, of Washington and Lee University.

The new officers of sections are as follows:

Astronomy, Mathematics and Physics: Chairman, Alexander Vyssotsky, of the University of Virginia; *Secretary,* F. B. Haynes, of the Virginia Polytechnic Institute.

Biology: Chairman, Bruce D. Reynolds, of the University of Virginia; *Sub-Chairman,* J. G. Harrar, of the Virginia Polytechnic Institute; *Secretary,* Lena B. Henderson, of Randolph-Macon Woman's College.

Chemistry: Chairman, W. J. Frierson, of Hampden-Sydney College; *Secretary,* William G. Guy, of the College of William and Mary.

Education: Chairman, John Alex Rorer, of the University of Virginia; *Secretary,* Paul G. Hook, of Clifton Forge.

Engineering: Chairman, Albert H. Cooper, of the Virginia Polytechnic Institute; *Secretary,* D. H. Pletta, of the Virginia Polytechnic Institute.

Geology: Chairman, E. R. Casto, of Emory and Henry College; *Vice-Chairman,* E. C. H. Lammers, Washington and Lee University; *Secretary,* William M. McGill, of the Virginia Geological Survey.

Medicine: Chairman, Carl C. Speidel, of the University of Virginia; *Secretary,* Guy W. Horsley, of Richmond.

Psychology: Chairman, Richard H. Henneman, of the College of Willian and Mary; *Secretary,* William M. Hinton, of Washington and Lee University.

The meeting next year will be at the Randolph-Macon Woman's College, Lynchburg, Virginia, and in 1941 at the Medical College of Virginia, Richmond, Virginia.

E. C. L. MILLER,
Secretary

THE KENTUCKY ACADEMY OF SCIENCE

THE twenty-sixth annual meeting of the Kentucky Academy of Science was held at Murray State Teachers College, Murray, Ky., on April 28 and 29. The principal address, on "Science and Human Mores," was given by the president, Dr. W. R. Allen.

Fifty-four papers were presented in six divisional meetings. Two divisions, the Kentucky Association of Physics Teachers and the Louisville Astronomical Society, met in joint session. A feature attraction at one of the two meetings of the Division of Biological Sciences was the color film showing "Animal Life in the Kentucky Mountains," made and given by W. A. Welter, of Morehead, Ky.

An annual cash award of $50.00 for five successive years has been placed at the disposal of the academy by Mr. and Mrs. Fain W. King, Wickliffe, Ky. This award is to go to the individual presenting the best and most original paper at the annual meeting. The recipient of the award for 1939 remains to be determined.

On Saturday, April 29, after a final general session at Murray, the academy was the guest of Mr. and Mrs. Fain King, at the "Ancient Buried City" at Wickliffe. This is an excavation of Moundbuilder ruins and burials on a bluff overlooking the Mississippi.

Newly elected officers for 1939–1940 are: *President,* A. W. Homberger, University of Louisville; *Vice-President,* Chas. Hire, Murray State Teachers College. Reelected were: *Secretary,* Alfred Brauer, University of Kentucky; *Treasurer,* Wm. J. Moore, Eastern Teachers College; *Representative* of American Association for the Advancement of Science on Council, A. R. Middleton, Louisville. *Councilor to Junior Academy,* Anna A. Schnieb, Richmond.

ALFRED BRAUER,
Secretary

SPECIAL ARTICLES

THE EFFECT OF CERTAIN CHEMICALS ON THE HATCHING OF MOSQUITO EGGS

IN a study of the factors affecting the hatching of mosquito eggs it was found that only 2 per cent. of the eggs of *Aedes vexans* Meig. and *Aedes aldrichi* Dyar and Knab would hatch when flooded with unmodified tap water or with water from the Columbia River. Since eggs of these species deposited on the soil among fallen leaves and grass of cottonwood and willow flats bordering the Columbia River hatch readily when these areas are flooded, it was thought that certain chemicals dissolved from vegetation might provide the necessary stimulus.

Experiments conducted to verify this idea showed that tap-water infusions of dry cottonwood leaves, willow leaves and grass gave consistently larger hatches than either tap or river water alone. Fallen leaves 3 to 6 months old which had dried at room temperature were used in making the infusions. The leaves were strained out with a coarse cloth before the liquid was applied to the eggs. Infusions made with green leaves also caused hatching. Eggs gathered in August and flooded with 2-hour infusions representing 2 or 3 milligrams of leaves per cubic centimeter produced the largest hatches. The egg-hatching stimulant was present in these infusions in small quantities within 10 minutes after the leaves were flooded at room temperature and reached its most effective strength in from 1 to 2 hours.

More extensive tests were made with eggs gathered in January and flooded after they had been kept at room temperature for 10 days to bring them out of their winter dormant condition. These eggs gave maximum hatches with infusions made from 10 milligrams of dry willow leaves per cubic centimeter of water. With infusions of this strength 80 per cent. of the eggs of both species hatched. The percentages of hatch for the two species showed close correlation at all strengths tested.

Preliminary tests with the eggs of *Aedes dorsalis* Meig. showed that these eggs also require the hatching stimulant supplied by leaves and grass. In tests with *Theobaldia incidens* Thomson, *Culex pipiens* L. and *Anopheles punctipennis* Say the eggs of all three species hatched readily in unmodified tap water. The eggs of *Theobaldia, Culex* and *Anopheles* are laid directly on the water, whereas those of the three species of *Aedes* tested are laid on the soil and hatch when flooded by rising rivers, high tides, etc.

In an effort to determine the nature of the egg-hatching stimulant, a number of organic chemicals and inorganic chemical elements necessary for plant and animal growth were tested individually and in combination. These did not cause hatching. However, it was shown that the stimulant was present in oats, milk and beef liver.

Pantothenic acid,[1] a recently discovered growth stimulant which is believed to be present in all living cells, occurs abundantly in liver, milk and yeast. The addition of infinitesimal amounts of the acid produces a remarkably stimulating effect on the growth of various types of plants and single-celled animals. The effects of this acid were therefore tested on the eggs in a medium composed of several chemicals in which the acid was produced by yeast. It was found that asparagine, one of the ingredients of the medium, caused the eggs to hatch and that potassium phosphate, another ingredient, acted to increase this hatch. As pantothenic acid was not available except in solution with these two chemicals, its effect could not be definitely determined, but it appeared to have no stimulating action. Solutions containing about 1 milligram of asparagine and 0.5 milligram of potassium phosphate per cubic centimeter of tap water produced the largest hatches, 77 per cent. of the eggs of *Aedes vexans* and 42 per cent. of those of *Aedes aldrichi* eggs.

Six amino acids were found which were stimulating to the eggs. These are asparagine, glycocoll, alanine, cystine, leucine and aspartic acid. The first two were most effective. Hatches were increased with both these materials when calcium or sodium phosphate was added. Putrecine, urea and potassium acetate also caused hatching.

It seems probable that the amino acids and proteins present in vegetation may be the stimulants which cause the eggs to hatch when flooded in nature. Further research work on the composition and action of the egg-hatching stimulant, the species affected by it and its relation to mosquito egg hatching in nature are under way.

C. M. GJULLIN
W. W. YATES
H. H. STAGE

BUREAU OF ENTOMOLOGY AND
PLANT QUARANTINE,
U. S. DEPARTMENT OF AGRICULTURE

AN OBSERVATION SUGGESTING THE PRESENCE OF A GONADOTROPIC HORMONE IN ROYAL JELLY[1]

THIS preliminary note presents evidence suggesting that extracts of royal jelly injected subcutaneously into immature female rats produce precocious development of the ovaries.

Royal jelly is an essential factor in the life of a colony of bees. It is secreted by glands in the mouth of the worker bee. It is fed to the queen while she is laying eggs and to all new-born larvae for the first three days of their lives; from then on only those larvae destined to become queens receive this special diet; queen larvae receive this food during their whole larval stage. All other female larvae, that is, those destined to become workers, are fed on nectar and pollen, after the first three days. These two types of females are strikingly different. The worker takes twenty-one days to develop from egg to adult, the queen sixteen; yet the queen bee is nearly twice as large as the worker. The worker can lay eggs only under extraordinary circumstances; the queen lays eggs steadily for as long as three or four years. The ovaries of the worker are infantile, while those of the queen are large. The worker exhibits many maternal instincts, the queen none. The fact that all these differences apparently could be produced simply by the giving or withholding of royal jelly led to the deduction that royal jelly might contain an active principle that would behave like a gonadotropic or growth hormone.

Hill and Burdett,[2] working on rats kept on a "vitamin E free diet," reported correction of this deficiency by the feeding of royal jelly. Mason and Melampy[3] later repeated this work and were unable to verify it when an actual vitamin E deficiency was established. Investigation of hormones in insects has only recently been undertaken. In this regard the contributions of Wigglesworth[4] and Weed[5] on the corpora allata and its relation to ovulation in insects are intensely interesting.

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[1] These tests were made possible through the cooperation of Dr. Roger Williams, of the Chemistry Department of Oregon State College, who kindly supplied the acid and assisted with the tests.

[1] From the Departments of Pediatrics and Surgery, Harvard Medical School, and The Children's Hospital, Boston.

[2] L. Hill and F. F. Burdett, *Nature*, 130: 540, 1932.

[3] H. K. Mason and R. M. Melampy, *Proc. Soc. Exp. Biol. and Med.*, 35: 459, 1936.

For the work reported in this communication, two extracts of royal jelly[6] were prepared with dilute NaOH and one with aqueous pyridine (Fevold[7]). Twenty immature female rats, twenty-one days old, were used. These had been raised and weaned under our observation and were all fed the same standard diet during the experimental period.

Ten rats of this experimental group were kept as controls. The remaining ten were injected with extracts of royal jelly. Amounts varying from 60 to 700 mgm of natural royal jelly equivalent were injected subcutaneously on each of five days; the average amount of extract in each injection was 0.3 cc. On the twenty-sixth day of life, the ovaries were removed from all twenty animals. The ovaries of the control group, as would be expected, showed primary follicles that were small and relatively inactive. The ovaries of the animals that had received royal jelly were moderately enlarged, with the Graafian follicles in varying stages of rapid maturation. There was little evidence of luteinization. The twenty control ovaries (two from each animal) averaged 9 mgm in weight; the twenty stimulated ovaries averaged 15 mgm. However, even the smallest of the stimulated glands showed unusual follicular activity. The vagina did not open in any of the controls or treated animals. The degree of the response was directly proportional to the strength and amount of the extract used. The pyridine extract was the most potent of those tried. All gained weight steadily, with the treated animals tending to be slightly heavier than the controls at the end of the experiment.

It is obviously too early in this investigation to draw final conclusions. It seems particularly interesting, however, that this material produced by an insect apparently contains a principle which behaves like a hormone when injected into an animal. The results presented in this communication prompt speculation as to the possibility of an anlage of Rathke's pouch, present in the bee and acting as the functional evolutionary fore-bear of the pituitary gland.

Summary: The injection of extracts of royal jelly into immature female rats for five days is attended by precocious development of the Graafian follicles.

Henry L. Heyl

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Boston

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[4] V. B. Wigglesworth, *Quart. Jour. Micr. Sc.*, 79: 91, 1936.

[5] I. G. Weed, *Proc. Soc. Exp. Biol. and Med.*, 34: 883, 1936.

[6] The author is grateful for the cooperation of Dr. R. M. Melampy, the A. I. Root Company of Medina, Ohio, Mr. Allan Latham, of Norwichtown, Conn., Mr. C. C. Ellison, of Belton, S. C., and Dr. Ouida Abbott, of Gainesville, Fla., who supplied the royal jelly used in these experiments.

[7] H. L. Fevold, F. L. Hisaw and S. L. Leonard, *Am. Jour. Physiol.*, 97: 291, 1931.

RECOVERY OF THE VIRUS OF EQUINE ENCEPHALOMYELITIS (WESTERN TYPE) FROM HUMAN BLOOD SERUM

On August 7, 1938, through the courtesy of Dr. Ellis Sox blood was received from a man at the Tulare County Hospital in the San Joaquin Valley, California. He had been admitted to the hospital on August 2 in a state of coma with a rectal temperature of 108° F. His earlier symptoms were those of severe headache, stiff neck and general malaise. The blood was taken on August 6, or not long before death from what was considered an acute encephalitis.

At the time this blood was received, the virus of equine encephalomyelitis had not as yet been recovered from a human case and had not been considered a possibility as the etiological agent of the encephalitic cases occasionally occurring in this region. However, neutralizing antibodies for the St. Louis encephalitic virus[1] had been found in many serums of the recovered patients so that this S serum was tested for antiviral properties. It was negative and the serum was stored in the refrigerator for future reference. After the later recovery of the equine virus from a human case,[2] this serum was remembered and on October 8, two months after collection, it was inoculated intracerebrally into two mice. Two weeks later one mouse became paralyzed in the hind legs. Both animals were killed, and a 10 per cent. suspension of their brains in Ringer's solution was passed on to other young Swiss mice.

After several serial passages a virus was established that killed mice in 4 days. Berkefeld filtrates of the brain material were also infective for mice. The virus was found to be infectious for monkeys, guinea pigs and rabbits with a four- to five-day incubation period, and typical symptoms for the virus of equine encephalomyelitis of the western type.

From the clinical picture in guinea pigs, a weak prostration, usually with a dragging of the hind legs, and a typical temperature curve rising to a maximum on the third day, the virus seemed to more closely resemble the original equine western type than did the other recently recovered human or Br strain previously described.[2] The latter was more virulent, being infective in a 1–10,000,000 dilution in mice, had a 60-hour duration accompanied by more spasticity when large doses were given and showed a more abrupt temperature curve in guinea pigs. The new S strain was infective to mice intracerebrally in a dilution of 1–100,000 and occasionally 1 to 1,000,000 and was also fatal by intranasal, subcutaneous and intracutaneous routes of injection.

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[1] B. F. Howitt, *Proc. Soc. Exp. Biol. and Med.*, 38: 334, 1938.

[2] *Ibid.*, Science, 88: 455, 1938.

Wild mice, *Peromyscus maniculatus*, could be infected intracerebrally with 0.03 cc of a 1–100,000 dilution of the virus. Young puppies also succumbed after injection by the same route. The virus could easily be grown on the chorioallantoic membranes of the developing chick, and is now in the 40th passage. The embryo dies in about 15 to 18 hours and the virus may be recovered from the membranes, the amniotic fluid and the tissues of the chick. The Br strain could likewise be grown in the developing egg.

Immune serums of the S strain gave positive neutralization and complement fixation tests against the Br and the western equine types of virus, but occasionally there was a slight crossing with the eastern variety by the first method. Eastern immune serums, however, failed to neutralize the S virus, as did also the immune serums of the Moscow 2 equine type and the Japanese B virus. Both tests were negative against the St. Louis encephalitic strain. There was no crossing with the eastern variety in the complement fixation test, although occasionally the S antigens were weak when used against the Br and the western equine serums. The S serums usually were positive against the other two western antigens. It was also found feasible to use as antigen the supernatant fluid after centrifugation of the ground membranes of eggs infected with either of the two strains.

In cross tissue immunity experiments, 3 out of 4 guinea pigs immune to the S strain succumbed after intracerebral injection of the eastern type, while the fourth became sick and weak but recovered. One old guinea pig immune to the latter virus, after inoculation with the S strain, ran a temperature and became ill but recovered.

From the general characteristics of this S strain, the incubation period, temperature curve, clinical picture in animals and from the serological and immunological reactions, it is apparent that the western variety of equine encephalomyelitic virus may be recovered from adult human blood serum even after prolonged storage in the refrigerator.

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ENCEPHALOMYELITIS IN MONKEYS

During the last few years equine encephalomyelitis has been spreading widely among the horses of the United States. Though the possibility of its infectiousness for man had been realized,[1] it was first recognized[2] last year as the cause of serious disease in man. Innumerable people are exposed during an epidemic in horses; and now many laboratory workers have intimate contact with the disease and its causative viruses while making the embryo vaccine[3] being used to control the disease. We have been carrying out experiments with monkeys to throw light on probable modes of human infection and to indicate what might be done to control or check the disease in man. These experiments have been designed to determine (1) the sensitivity of monkeys to infection by different routes; (2) the influence of hyperimmune serum on the course of the disease; and (3) the possibility of protecting by vaccination.

It has been known[4] that monkeys are susceptible to encephalomyelitis virus injected into the brain and that they can in some instances be infected by virus introduced into the peripheral circulation. We have found that when a massive dose of either eastern or western virus is instilled intranasally into a young rhesus monkey, it will in most instances succumb to a fatal infection. The first symptom of this infection has been fever. The animal has been mildly excitable during this febrile stage, after which it has become paralyzed, has sunk into coma and has died. The symptoms of the two American diseases have been similar, except that as in other animals, the eastern has run a shorter course. We have never observed the recovery of any young monkey infected with either strain if it became paralyzed. A few of the animals receiving intranasal virus have remained healthy; we have found that at least some of these monkeys developed a high content of neutralizing antibodies after exposure. They have therefore suffered non-clinical infections. In our experiments disease has not been produced by very large doses of virus injected subcutaneously or intravenously, though these inoculations have been followed by the appearance of circulating antibodies. Dropping virus into the eye has not resulted in either disease or measurable antibodies. Eastern virus injected intralingually and western virus introduced by stomach tube have proved fatal, but we have not diseased healthy animals by keeping them caged with sick ones.

Hyperimmune horse serum has provided passive protection against nasally instilled virus. Incomplete protection has been furnished by serum administered within three hours of infection. In numerous trials we have never seen any beneficial effect from such a serum given at and after the time of first temperature rise, even when this serum was equivalent in amount to the injection of 500 cc into a 150-pound man.

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[1] K. F. Meyer, *Ann. Int. Med.*, 6: 645, 1932.

[2] L. D. Fothergill, J. H. Dingle, S. Farber and M. L. Connerly, New England Jour. Med., 219: 411, 1938; L. T. Webster and F. H. Wright, Science, 88: 305, 1938; B. F. Howitt, Science, 88: 455, 1938.

[3] J. W. Beard, H. Finkelstein, W. C. Sealy and R. W. G. Wyckoff, Science, 87: 89, 490, 1938.

[4] E. W. Hurst, *Jour. Path. Bact.*, 42: 271, 1936.

Animals twice vaccinated with crude chick embryo vaccine have in all but one instance been completely protected against massive doses of intranasal virus. This vaccination has produced antibodies which were present in high titre after eastern, in lower titre after western vaccine injection. Such titres were not appreciably enhanced by the subsequent test dose of virus. Clarified and deformalinized embryo vaccines have now been made which have been effective in guinea pigs and which should be more suitable for any human use that may in the future be needed.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A HIGH RESOLVING POWER ULTRACENTRIFUGE

In the case of most large molecular weight substances the molecular weights and sizes are determined by measuring the rates with which they settle out in an ultracentrifuge, together with their diffusion constants.[1] Usually the material is enclosed in a sector-shaped cell with transparent windows so that the rate of sedimentation can be observed optically. Since the diffusion constants are very small for large molecular weight substances, the sedimentation boundaries remain comparatively sharp for long periods of time provided the substance is homogeneous. If the substance contains two or more molecular species, each forms a separate sedimenting boundary. The ability of an ultracentrifuge to separate a mixture of molecular species is proportional to $\omega^2 r h$, where ω is the angular velocity of the centrifuge, r the distance from the axis of rotation and h the length of the column of solution which may be observed.[1] In the modern ultracentrifuges the strength of the rotor materials sets an upper limit to ω, r and the height of the cell, h, that can be used.[1,2] The purpose of this note is to describe briefly a method which, in effect, increases the length of the column of solution under observation without increasing the length of the cell. The method consists in forcing the solution through the transparent cell along the radius in the opposite direction to the motion of the sedimentation boundary. Consequently, if the rate of flow of the solution is equal to the rate of sedimentation, the sedimentation boundary remains stationary in the cell for long periods of time. This not only allows the sedimentation constants to be measured with precision but also makes it possible to determine the sedimentation constants for two or more molecular species in a mixture with very small differences in molecular weight.

Fig. 1 shows a cross-section of the ultracentrifuge rotor which was used to make a preliminary test of the method. This rotor was spun inside an evacuated chamber by an air-supported air-driven turbine (not shown but described previously[2,3]) situated above the vacuum chamber. The shaft A is a stainless steel tube which connects with the tubes B. B connects with a ring-shaped tube D, which in turn communicates with the periphery of the cell C. The cell C is sector-shaped with crystal quartz windows for viewing the sedimentation; it is 12 mm long and its center is 45 mm from the axis of rotation. Short channels connect the ends of the cell C and the cylindrical collecting chamber E. To operate the apparatus the rotor is accelerated to the desired speed, and the material to be centrifuged is injected into A with a hypodermic syringe. The material flows through B, D, and into the cell C. In this way the cell is filled about two thirds. Then as the sedimenting boundaries move outward toward the periphery, more material is injected into A at the proper rate to maintain the boundaries near the center of the cell. The solvent is collected in the chamber E. In most of these preliminary tests hemoglobin (kindly furnished by Professor A. Chanu-

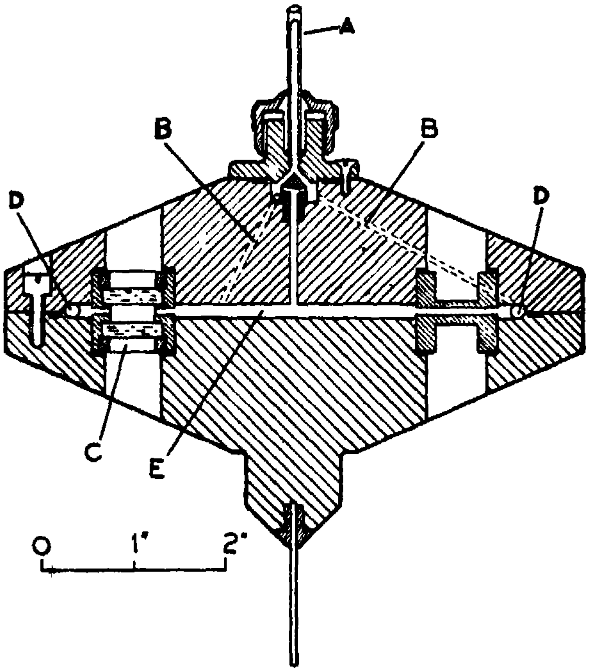

Fig. 1

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[1] Svedberg, *Ind. Eng. Chem., Analytical Ed.*, 10: 113, 1938; *Proc. Roy. Soc.*, A 170: 40, 1939.

[2] Beams, *Rev. Mod. Phys.*, 10: 245, 1938.

[3] Beams, Linke and Sommer, *Rev. Sci. Inst.*, 9: 248, 1938.

tin) was used. It was found that the sedimentation could be observed for practically as long as desired, the limiting factor apparently being only a blurring by diffusion (a dilution due to the field gradient also was noticeable). The sedimentation of colloidal particles very much larger than the hemoglobin molecules also was observed until E was filled. The preliminary tests indicate, in accord with theory, that the resolving power of the ultracentrifuge can be much increased, at least in some cases. A new and stronger rotor with the cell further from the axis is under construction with which further tests will be made.

The writer is greatly indebted to Messrs. Fritz Linke and Philipp Sommer, instrument makers, who constructed the apparatus, and to the Rockefeller Foundation for a grant in support of the development of the ultracentrifuge.

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A SMALL HYGROMETER

THE construction of a hygrometer that was much smaller and more sensitive than the usual commercial equipment became a necessity during the course of an experiment in which the relative humidity of a long narrow sealed tube had to be determined without changing its humidity by opening it.

This instrument is shown in Fig. 1. It consists of the balance wheel, hair spring and small portions of the bearing plates of a small jeweled wrist watch attached to a glass plate. To the escape nub on the arm of the balance wheel is attached a very fine human hair carefuly washed in ether and alcohol. It then bends over the shaft of the balance wheel and is attached at the opposite end of the glass plate under slight tension produced by the hair spring. A very fine glass rod attached to the circumference of the balance wheel indicates the motion produced by the elongation or contraction of the hair with humidity changes. A more sensitive measurement may be obtained by attaching small mirrors to the rim of the balance wheel and the regulator arm and using the distance between the spots of light reflected as an indicator of the motion produced by humidity changes.

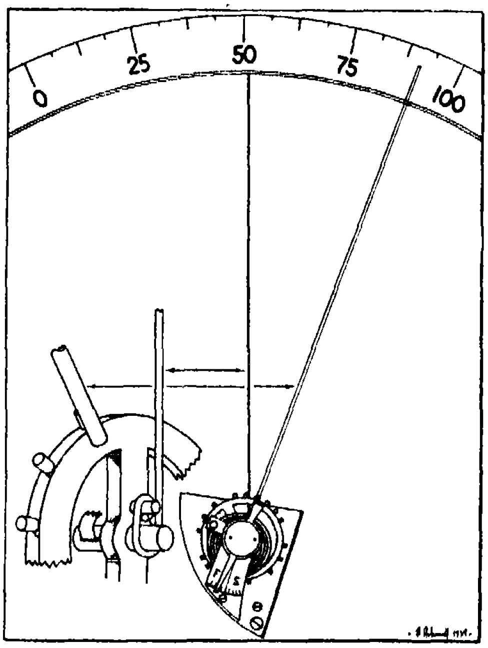

FIG. 1

The instrument was calibrated and checked by alternately placing it in a closed chamber first over water and then over concentrated H_2SO_4. All readings were within 2 per cent. R. H. When placed above salt solutions in closed containers, the instrument checked to about 1 per cent. in every instance. Under these conditions equilibrium was reached within 15 minutes.

The advantages of this instrument are threefold. (1) It is quite accurate and may be easily read without altering the humidity in the chamber. (2) As the small size makes its use in very small spaces possible without changing the humidity, humidity of microclimates may be obtained. (3) It is inexpensive and easy to construct.

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THE TEACHING OF PHYSIOLOGY[1]

By Professor **AUGUST KROGH**

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I have been engaged in physiological research and in teaching human physiology for about forty years during a period in which the most astounding progress has been made, and the subject from being of mainly academic interest has developed into being of deep significance for the welfare of mankind.

I wish to contend that the teaching of this branch of natural science has not kept pace with its increasing significance, that it should be taught to a larger number of people and in a more effective way than is usual at present.

I am not now concerned with the teaching of physiology to the small number of students who are going to engage in physiological research; they can pick up their factual knowledge during their apprenticeship, but I am thinking of all those people who need some knowledge of physiology to order their own lives and in their respective trades and professions, and my major contention is that this knowledge should be imparted mainly in a utilitarian way without any attempt to cover the whole subject as academically defined and delimited, but stressing definitely those parts of it which are most useful from the point of view of the pupils and therefore most likely to catch and hold their interest. I am convinced that at all stages the active cooperation of the pupils in the acquisition of this knowledge should be obtained.

Adopting this as my guiding principle, I would like to have the fundamentals of nutrition introduced as a subject in all lower schools—at least in the cities. While it is no doubt true that the instincts of children could guide them to a right selection of natural foods, this does not hold at all in the highly artificial environment in which most children are brought up; and they should learn for their own sake and for that of future generations something about food values and the effects of stimulants in common use.

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[1] An address delivered before the American Academy of Arts and Sciences, Boston, on May 10, 1939.

I would also, on principle, include in the curriculum for all adolescents the elements of sex physiology, but how far this is practicable must depend upon local conditions.

Going to deal now with the teaching of those classes in society which claim to be educated, I wish to record the fact that in Denmark human physiology was introduced in 1908 as a regular subject for all high-school pupils at the age of seventeen to eighteen years. We have nothing to compare with American colleges, and our high schools (called gymnasia) prepare directly for the universities. Allowing for considerable differences in methods and courses, the teaching of these youths corresponds to that in the two first years in college. The pupils, or those responsible for them, have to choose between three lines of education: one stressing classical languages; one, modern languages; and one, mathematics and natural sciences.

Both languages and science are taught, however, to the pupils along all the lines, and a knowledge of human physiology is considered a necessary and essential element of any liberal education.

Pupils, teachers and education authorities are in essential agreement that this subject has proved interesting in itself and of high educational value. I have no doubt that from the point of view of formal education, corresponding values could be obtained from other branches of biological science and that a presentation of the facts of general physiology is even logically preferable, but the natural interest of the pupils centers around their own organism, and here again I would strongly emphasize the utilitarian point of view. A knowledge of the bodily functions and some of their most common disturbances is, on the whole, useful knowledge, and a fairly large number of the pupils will find that this or that bit of it applies directly to their own case.

The physiology taught in our gymnasia is fairly comprehensive, although, of course, elementary. It utilizes the chemistry and physics which the students have at this stage been taught, and it covers the functions of digestion, circulation, respiration, excretion, etc. Nutrition is dealt with at some length, and the functions of endocrines and gonads are included. The nervous and muscular systems are treated in a somewhat summary fashion, but the sense organs, especially the eyes, in more detail. I may perhaps be allowed to refer for further information to an American edition of my own text-book published in 1934 and now therefore largely out of date.

The men and women who teach physiology on this level must themselves possess a sound and a wider knowledge of the subject, and it is essential that during their university training they should have grasped its character as a living and rapidly growing subject so as to be ready to assimilate and utilize the progress made during their subsequent teaching careers and not to be dogmatic on any point. In Denmark we think it important that they should be trained to perform and demonstrate to their pupils simple physiological experiments—mostly on human beings. I have been responsible for the university training of these teachers for thirty years, and although comparative physiology is my favorite field, I have not considered myself justified in introducing more than a few especially striking examples into the curriculum.

Familiarity with certain aspects of physiology is useful or even essential in certain professions. Dentists must know something about nutrition, and engineers ought to know something about the human organism as a motor; but for very large parts of our science, they have no direct application, and there is no reason why they should have more information on these parts than any educated citizen.

The profession in which human physiology is most useful and for which it is now in fact *the* basic science is the medical.

Forty years ago the recognized basis for clinical medicine was morbid anatomy, and the contributions of physiology to medicine as then taught and practised were not numerous, nor were they considered especially important.

The situation now is fundamentally different. Morbid anatomy is still important, of course, but disease is first and foremost a functional disturbance, and how far it can be controlled depends largely upon our understanding of normal and abnormal function. I am happy to state that the conception is gaining ground in this country that the teaching of physiology in medical schools has for its object to educate students to become doctors and not to become dabblers in the experimental and theoretical science of physiology, but tradition is strong, and, as I see it, there is still a great deal that will have to be weeded out from physiological curricula in medical schools and a great deal that will have to be put in. We have to start with the assumption that the students enter medical school because they are interested in medicine, and it is the duty of teachers to make it clear to them at every stage that what is taught has a bearing upon medicine and is going to help them to become good doctors. If this conception is kept in view, it should not be so very difficult to illustrate the teaching of physiology with clinical examples and to stress those phases which have a definite clinical bearing, as, for instance, the central and peripheral disturbances of circulation, the formation and absorption of edema, etc. It is a difficulty, of course, that in the preclinical stage in which physiology is mainly taught the pupils know very little about medicine, but I am convinced that this difficulty can be largely overcome. The practical courses should not, in my opinion, be arranged to introduce the pupils to the intricacies of physiological experimentation, but, beyond illustrating some basic principles, they should familiarize the students with methods actually useful in medicine. The growth of the science should be emphasized, and it should be taught how to find and use original literature.

I feel very definitely that the practice adopted by a few schools of giving those students who desire it an opportunity to reestablish a close connection between physiology and medicine is very beneficial. It can be done, as I have seen, by establishing courses for older students given jointly by clinical and physiological teachers, but other methods are no doubt available.

I have been much in favor of special chairs for the study and teaching of pathological physiology, and I still think that it may be, in certain circumstances, a useful development, but it would serve as an excuse to make the preclinical teaching too academic, and when a close cooperation can be established between those who teach physiology (normal *and* pathological) and those who teach clinical medicine and surgery, I think the best results can be achieved.

It may be said that the system which I advocate would discourage students from going into physiological research. My reply would be: So much the better. Students should be discouraged from choosing a career involving research, and we should welcome only those whose urge is strong enough to overcome discouragement and difficulties.

THE MODE OF ACTION OF SULPHANILAMID[1]

By Professor PHILIP A. SHAFFER

DISCOVERY of the dramatic therapeutic effect of sulphanilamid in various bacterial infections has stimulated wide-spread interest and renewed activity in the field of chemotherapy for infectious disease. From this renewed activity there should come the discovery of still better drugs for the control of infections. Progress in this new era of chemotherapy is likely to depend a good deal on an understanding of the ways in which the drugs exert their action; without that understanding the search for more useful therapeutic substances is apt to be largely a haphazard venture. It is therefore disappointing to find that in spite of the numerous investigations with sulphanilamid and related compounds there is yet no accepted explanation of their action. In Marshall's recent review of the pharmacology of sulphanilamid,[2] he states: " . . . no satisfactory explanation of the mechanism of action has been found." Yet certain facts have been known for some time which appear to point plainly enough in the direction of a logical explanation. The purpose of this communication is to draw attention to these facts and to cite briefly some new evidence, all of which when combined seem to provide an explanation of the mode of action of sulphanilamid and of related substances.

In June, 1937, R. L. Mayer pointed out[3] that the frequent appearance of methemoglobin in the blood of animals and patients treated with sulphanilamid suggests the formation in the body of an oxidation product of the drug which is responsible for the formation of methemoglobin. He further advanced the hypothesis that the bactericidal effect is due not to sulphanilamid but to the same oxidation product which oxidizes hemoglobin to methemoglobin. In support of this idea Mayer showed that p-hydroxyl amin benzene sulphonamid is highly bactericidal, as the corresponding amine is not. It is the opinion of the present writer that this hypothesis contains the important germ of truth, and if substantiated and developed may supply a rational chemical basis for this important branch of chemotherapy. Should this expectation prove to be correct it will represent the extension of a point of view that prompted Ehrlich in his early experiments with oxidation-reduction dyes and will incorporate also some of Pasteur's ideas on the relationship of fermentation to respiration.

The following facts would seem to be conclusive evidence that sulphanilamid and sulphapyridin are not themselves bactericidal and that their therapeutic (and toxic) effects are due to oxidation products of these substances formed by atmospheric oxygen under the catalytic influence of respiring tissues or organisms.

(1) Both drugs are wholly without effect on the growth of bacteria in the absence of oxygen. Both become more or less bacteriostatic or bactericidal under certain aerobic conditions, but promptly lose this property when the culture media become anaerobic in consequence of bacterial metabolism and the resulting consumption of dissolved oxygen.

The oxidation products of a number of more or less analogous substances, for example, benzoquinone and quinhydrone, are known to be highly bactericidal under anaerobic as well as aerobic conditions, whereas the reduced forms are bactericidal only under aerobic conditions, *i.e.*, when their oxidation is possible.

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[1] From the Laboratory of Biological Chemistry, Washington University School of Medicine, Saint Louis.

[2] *Physiological Reviews*, 19: 254, April, 1939.

[3] *Bull. L'Academie de Med.*, 1937, 117: 727, 1937.

(2) When sulphanilamid is given to animals infected by streptococci there is a "lag" of some hours during which little or no inhibition of bacterial growth occurs, after which period the number of bacteria in blood and tissues may rapidly decrease or disappear. This again suggests the inactivity of sulphanilamid as such, but does not prove the active substance to be an oxidation product.

(3) The presence of methemoglobin in the blood of virtually all animals or patients receiving therapeutic doses of sulphanilamid is, as Mayer pointed out, significant. Methemoglobin is the *oxidized* form of hemoglobin, and the appearance of this pigment is probably always indicative of the presence in the blood of an active oxidizing agent not normally there. It is reasonable to suppose that the agent present after giving sulphanilamid is an oxidation product of sulphanilamid.

(4) Active *oxidizing* agents, of sufficient oxidizing intensity, are known to be highly bactericidal for many organisms, provided their oxidizing action is not diverted from the bacteria by being consumed by other reducing substances in the culture fluid. A demonstration by W. M. Clark illustrates this qualification. Many times the lethal concentration of iodine may be added to bacterial cultures without bactericidal effect, if added so slowly as to be at once reduced to iodide ion, thereby avoiding an excess of I_2 and the consequent rise of the oxidation potential of the medium. Similarly, Dubos and others have shown that streptococci and various other organisms do not grow when the oxidation potential of the media is kept above certain levels. The reducing intensities of living cells, produced by the "activation" of metabolites by "dehydrogenase" enzymes, provide one environmental factor essential for growth and in the case of many bacteria essential for life. That essential environment is destroyed and the organisms are killed by such excess of active oxidant as will maintain the oxidation potential above a critical level.

(5) It has recently been reported[4] that sulphanilamid added to broth raises the electrode potential and somewhat delays its fall as growth proceeds. This effect is due to the oxygen (and possibly H_2O_2) contained at the start in the broth since it was not observed under anaerobic conditions or when cystein was added. Sulphanilamid is not an oxidant and is itself inactive toward electrodes. When, however, even a very small fraction is oxidized (as occurs slowly in aqueous solutions exposed to light and air), the product (until reduced or decomposed) imposes a high potential, as will be explained below.

(6) It has been found by Shinn, Main and Mellon[5] that the oxidation product of sulphanilamid produced by radiation (Ottenberg and Fox) destroys catalase and thus allows H_2O_2 to accumulate in respiring bacterial cultures. From this observation they advance the hypothesis that the bactericidal action is due to H_2O_2.

To the above significant observations the writer is able to add the following facts.

Although virtually unaffected by atmospheric oxygen in the absence of catalysts, sulphanilamid and sulphapyridin are readily oxidized to characteristic cherry-reddish products by a number of chemical oxidants as well as by electrolytic oxidation. The identity of the products has not been established, but circumstantial evidence suggests what they are. The products are the same regardless of the oxidizing agent used, and are therefore derivatives of sulphanilamid (or sulphapyridin) and not of the reagent used to oxidize it. In the oxidation four equivalents are consumed per mole of sulphanilamid oxidized, which points to the conclusion that the primary end-product of oxidation is nitroso-benzene sulphonamid. Among the agents used are ceric sulphate, chlorine water, sodium bismuthate, MnO_2, $KMnO_4$, ferric-ortho phenanthroline, PbO_2, and H_2O_2 (with Fe^{++} as catalyst). The last two are especially effective. Less intense oxidants, such as ferricyanide, I_2, $K_2Cr_2O_7$, vanadic acid, thallic sulphate, do not attack sulphanilamid or sulphapyridin rapidly at room temperature. Ferric ion is reduced to a slight extent. Bromine is instantly consumed by bromination of the ring.

It proves to be possible to measure the oxidation intensity of the products by platinum or gold electrodes. The products are rather unstable and do not give steady potentials. The potential falls rapidly and conventional curves characteristic of stable reversible systems are not obtained by titration. Nevertheless, there is fair reproducibility of potentials and rather good agreement among several different electrodes in the same solution. Approximate agreement of potentials is obtained with different oxidizing agents at the same pH levels. These features are regarded as justifying the belief that the observed potentials arise from and represent finite ratios of electromotively active substances, and so constitute significant and characteristic intensity levels of the substances from which the products are formed. If this belief proves to be correct, the measurement of potentials should be an important criterion in the search for new therapeutic agents of this type.

The relation of the observed potentials to "normal" potentials of the systems has not yet been established. Sulphanilamid concentration has no effect upon the potential, and the parent substance is therefore not a member of the electromotive pair. It is probably a fairly safe guess that the reversible electrode couple is composed of the hydroxyl amin and nitroso derivatives or the corresponding semi-quinone free radicals. The following evidence may be cited in support of this conclusion. Neither aniline nor nitrobenzene are active toward electrodes, while the corresponding intermediates, phenyl hydroxylamin and nitroso benzene, are active. Conant and Lutz[6] measured the potential of an equimolar mixture of the two last-named substances in 0.1 N HCl, (+0.605 v.). On oxidizing a solution of aniline in the same solvent by PbO_2 we find an initial potential about 0.1 v. higher which rapidly falls to and below this "normal" value. This behavior would be expected if the oxidation products were a mixture of the hydroxyl amin and nitroso forms, with the nitroso derivative decomposing at a faster rate.

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[4] Fox, German and Janeway, *Proc. Soc. Exp. Biol. Med.*, 40: 184, February, 1939; and Warren, Street and Stockingen, *ibid.*, 208.

[5] *Proc. Soc. Exp. Biol. Med.*, 40: 640.

The measured potentials of oxidized sulphanilamid solutions, as might perhaps be expected from the intense oxidants needed to form them (though there is no necessary connection), indicate an astonishingly high oxidizing intensity for these products. At pH 4.6 the plateau potential (E_h) of sulphanilamid oxidant is + 0.59 v. At pH 1.8 (0.1 N H_2SO_4) the potential of sulphanilamid oxidation by ceric ion is + 1.07 v. Measurement of potentials at pH 7 has not been successful for technical reasons. It is of interest, and is perhaps significant, that the potential of sulphapyridin at pH 4.6 is 30 or 40 mv. higher than that of sulphanilamid. For the potential measurements I am indebted to Dr. E. S. Hill.

The oxidation products are highly reactive, and fortunately the intensity levels indicated by the electrode potentials can be confirmed in a rough but convincing way by chemical reactions. The oxidized products are quickly reduced by hydroquinone, diphenylamine, p-phenylene diamine, p-amino phenol and in part by ortho-tolidine but not by benzidine, in part by iodide ion (with liberation of I_2) and by ferrous ion. They are also promptly reduced by oxyhemoglobin, which is thereby oxidized to methemoglobin, and also to other unknown products which are suggestive of the brown pigments observed in the blood of cyanotic patients treated with sulphanilamid. The intensity levels and potentials of the oxidation products of sulphanilamid therefore lie above those of the reductants named. It follows also that if these or other more reducing substances be present with sulphanilamid when it undergoes oxidation, only these and not sulphanilamid will appear to be oxidized. Metabolites activated by cells, many cell constituents and substances present in peptone broth culture media are such reducing substances. In their presence bacteria might be more or less protected from the effect of slowly oxidized sulphanilamid. But if not at once reduced, the activity and oxidation intensity of the products of sulphanilamid are such that they would certainly exert on bacteria much the same lethal effects as would like concentrations of I_2 or Br_2. (The oxidation products are, of course, highly bactericidal *in vitro*). Because of the presence in tissues and tissue fluids of many reducing substances it would appear to be hopeless to expect to find the oxidation products of sulphanilamid in living cells; perhaps it may be possible to find them in dead tissues.

The question naturally arises: Is it possible that a substance so difficult of oxidation as sulphanilamid could be attacked by oxygen in living cells? The same question might be asked about acetic acid or sugar or fat. To be sure, these are made reactive by enzymes, while there is no evidence that enzymes activate sulphanilamid. But activation of the drug is not necessary. It may be recalled that oxygen has an oxidizing intensity represented by + 1.23 v. (at one atmosphere pressure and at 0 pH). For comparison with our measurements of sulphanilamid at pH 4.6, the corresponding value for O_2 at one atmosphere is + 0.95 v. and at 50 mm Hg pressure + 0.78 v. The energy factor raises no difficulty. Confirmation of this conclusion is found in the fact that epinephrine is rapidly oxidized in the body. Its potential (Ball, *Jour. of Biol. Chem.*, 102: 691, 1933) is in the same region as that observed in sulphanilamid oxidation.

But the question remains: How could so intense an oxidant as necessary to oxidize sulphanilamid (or adrenalin) be formed in living cells? A tentative answer may be formulated somewhat as follows. The lethal oxidizing intensity of O_2 would presumably exert itself on all respiring cells if the oxygen molecule were to react by the formation of two molecules of water; it is this reaction for which O_2 has a potential of 1.23 v. This possibility is avoided by the formation of H_2O_2 instead of water. For the formation of H_2O_2 the potential of O_2 is only + 0.26 v. at pH 7. Without catalysts H_2O_2 is strangely inert at low concentration. But with metal catalysts present in cells it is an even more intense oxidant than O_2. The enzyme catalase, however, rather promptly and completely destroys H_2O_2, thereby protecting the cell from higher than about 0.26 v. (the level of cytochrome). If, however, substances are introduced which are freely permeable and are capable of oxidation even to a slight extent to reactive products the potentials of which are high, then such active oxidants may attack and oxidize functional components of the cell which are otherwise protected from O_2 and H_2O_2. The potential of the oxidation products of sulphanilamid at pH 7 (calculated from values observed at pH 4 to 5) is + 0.45 v., which is considerably higher than the normal potential of any other organic substance yet measured (except sulphapyridin and adrenalone). Every reactive reducing system in cells would be attacked by so energetic an oxidant. Among the cell components which would be oxidized are catalase (a ferrous hemin complex), hemoglobin, glutathione, sulphhydryl groups, ascorbic acid and so forth. With catalase more or less inactivated, H_2O_2 would accumulate locally. And H_2O_2 with ferric or ferrous ion (present in serum and tissues) is a rapid oxidant of sulphanilamid and of sulphapyridin. Once slowly started, more and more of the toxic oxidation products would thus be formed, in proportion as O_2 is available and H_2O_2 is produced. Bacteria in the blood stream and in regions of rich blood supply should be most exposed to the bactericidal effects. The appearance of methemoglobin is evidence of activity in the blood. Conversely, bacteria sequestered in tissues or locations (abscesses) with poor blood supply may be expected to be less accessible to the bactericidal effects. The relative immunity of host tissues to toxic effects is perhaps due to their lower oxygen tension, their higher metabolism and to higher catalase content. A dominant reducing environment should protect tissues from the sulphanilamid products in the same way as bacteria are protected from I_2 in Clark's demonstration above mentioned. In general, these hypothetical expectations appear to be in accord with clinical and experimental experience.

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[6] *Jour. Am. Chem. Soc.*, 45: 1059, 1923.

As the writer sees the evidence now available, the probable mode of action of sulphanilamid is that outlined in the above statement. The drug provides a mechanism by which the sterilizing oxidation intensity of molecular oxygen is applied nearly at its maximum to bacteria and unavoidably also to some extent to host cells. It is not surprising that toxic as well as therapeutic effects are observed from the use of such substances.

If the ideas here advanced are even in part correct, the new era of bacterial chemotherapy will be directly concerned with that fund of systematic information dealing with oxidation-reduction potentials and with the relation of molecular structure of organic substances to potential levels, as well as with the fascinating complexities of reactions that occur particularly among the intermediate oxidation stages of nitrogenous compounds.

From this store of information a number of predictions can at once be made. For example, if high potentials are desired, ortho rather than para substitution of the oxidizable group may be preferable. It is unlikely that the sulphonic acid group is essential to activity, though it does raise potentials and increase solubility. Hydroxyl rather than amino compounds may be useful. The applicability of these and other similar ideas will be explored and tested in future work in this laboratory.

SCIENTIFIC EVENTS

FELLOWSHIPS IN THE NATURAL SCIENCES OF THE NATIONAL RESEARCH COUNCIL

THE National Research Fellowships Board in the Natural Sciences of the National Research Council has made the following appointments for the academic year, 1939–1940:

John Nathaniel Adkins (Ph.D., seismology, University of California, 1939). The Massachusetts Institute of Technology. "The Electromagnetic Response of an Ellipsoid Imbedded in a Conducting Material."

Daniel I. Axelrod (Ph.D., tertiary paleobotany, University of California, 1939). The United States National Museum, Washington, D. C. "The Late Tertiary Floras of the Great Basin Province."

Richard Henry Bolt (Ph.D., physics, University of California at Los Angeles, 1939). The Massachusetts Institute of Technology. "The Wave Theory Approach to Room Acoustics."

Herbert Leonard Eastlick (Ph.D., chemistry, Washington University, 1936). The University of Chicago. "A Study of Pigmentation, Muscle Development, etc., by Means of Reciprocal Heteroplastic Transplants between Different Species of Avian Embryos."

Eugene Henderson Eyster (Ph.D., physical chemistry, the California Institute of Technology, 1938). The University of Michigan. "The Application of Infra-red Spectroscopy to Problems of Molecular Structure."

Frank Junior Fornoff (Ph.D., chemistry, the Ohio State University, 1939). University of California. "The Establishment of Subgroups within the Rare Earth Group of Elements by Means of Heat Capacity Studies of Rare Earth Salts."

Jackson Walter Foster (Ph.D., soil microbiology, Rutgers University, 1939). The University of Cambridge, England. "Respiration Studies on Filamentous Fungi."

Orville Goodwin Harrold, Jr. (Ph.D., mathematics, Stanford University, 1936). The University of Virginia. "The Structure of Semi-schlicht Images of a Compact Metric Space with Especial Reference to (k, 1) Transformations. The Topology of Rectifiable Curves."

Norman Harold Horowitz (Ph.D., embryology, the California Institute of Technology, 1939). Stanford University and Hopkins Marine Laboratory. "An Investigation of the Respiratory Enzymes of Developing Marine Eggs."

John Oliver Hutchens (Ph.D., zoology, the Johns Hopkins University, 1939). The Carlsberg Laboratorium, Copenhagen, Denmark. "The Carbon and Nitrogen Metabolism of Chilomonas Paramecium."

Francis Philip Jahn (Ph.D., physical chemistry, New York University, 1938). Princeton University. "Azoethane: Preparation, Pyrolysis and Photolysis, Molecular Spectra and Thermodynamic Properties of Azoethane."

Ralph Ernest Lincoln (Ph.D., genetics, the Iowa State College, 1939). Cornell University. "Mutation in *Bacterium stewartii* Including Its Pathogenicity on Maize."

John Lafayette Magee (Ph.D., chemistry, University of

Wisconsin, 1939). Princeton University. "A Theoretical Treatment of Photochemical Processes."

Joseph Miller (Ph.D., psychology, Yale University, 1939). Stanford University. "An Analysis of the Temporal Gradient of Reinforcement in Human Subjects and Its Application to Serial Behavior Sequences."

Jack Edgar Myers (Ph.D., botany, University of Minnesota, 1939). The Smithsonian Institution, Washington, D. C. "A Study of the Development of Photosynthetic Activity, Especially as it Relates to the Development of the Plant Pigments."

Myron Hiram Nichols (Ph.D., physics, the Massachusetts Institute of Technology, 1939). Princeton University. "Thermionic Work Function of Thoriated and Caesiated Tungsten for the Different Crystal Faces."

John Booth Peterson (Ph.D., soil fertility, the Iowa State College, 1936). University of California. "The Relation of the Composition of Soil Binding Material to the Stability of Soil Aggregates and the Resistance of Soils to Erosion."

Jean Barnett Piatt (Ph.D., zoology, Yale University, 1937). The University of Utrecht, Holland. "The Specificity Relationship between Individual Motor Fibers and Their Normal Muscle Field in Regenerated Forelimbs of Triturus Pyrrhogaster."

John Robert Raper (Ph.D., general biology, Harvard University, 1939). The California Institute of Technology. "The Sexual Mechanism in the Saprolegniales."

Julian Seymour Schwinger (Ph.D., physics, Columbia University, 1939). University of California. "The Theory of Nuclear Forces."

Dorothy J. Shaad (Ph.D., experimental psychology, Bryn Mawr College, 1934). The Harvard Medical School. "The Value of Controlled Bifoveal Stimulation in the Correction of Anomalous Visual Projection."

Wave Henry Shaffer (Ph.D., physics, the Ohio State University, 1939). The University of Chicago. "Interpretation of Band Spectra of Polyatomic Molecules."

Saul Winstein (Ph.D., organic chemistry, the California Institute of Technology, 1938). Harvard University. "Studies in the Walden Inversion and the Allylic Rearrangement."

George Prior Woollard (Ph.D., structural geology, Princeton University, 1937). Lehigh University. "Investigations of the Geologic Structure beneath the Atlantic Coastal Plain and Related Areas by Means of Seismic and Gravity Profiles."

EXHIBIT OF THE AMERICAN GEOGRAPHICAL SOCIETY

A comprehensive exhibit of geographical data, maps, charts and tools of geographical research was opened on May 19 by the American Geographical Society of New York City. The exhibit, which will be free to the public while the World's Fair is in progress, was opened by W. Redmond Cross, chairman of the council of the society, at a private showing for the society's fellows. Captain Robert A. Bartlett, Arctic explorer, was a special guest for the occasion.

The exhibit is divided into sections dealing with exploration and field research, geographical fundamentals, New York City, primitive and historical maps, United States Coast and Geodetic Survey, the polar regions, photographic mapping, map of Hispanic America, economic and social conditions in the United States and international affairs. It will be open to the public from 2 P.M. to 5 P.M. daily except Mondays and Thursdays throughout the World's Fair season.

The society has prepared the exhibit as its share in providing features of unusual interest for visitors to the World's Fair. This is the first time in its eighty-six years of history that it has offered an exhibit of this nature to the general public.

Among the features of the exhibit are:

1. A map mounted on a section of the earth's surface which, if complete, would be nearly 132 feet in circumference. This section shows the actual curvature of the earth on a scale of 1: 1,000,000 and is covered with a map on that scale of the widest part of South America, from the Pacific coast of Ecuador and Peru to the Atlantic coast of Brazil. On this map, on the same scale, Mt. Everest would be 0.35 inch high and the sun would be about as far away as Philadelphia.

2. Field equipment for a modern high-altitude expedition. A nine-pound, two-man tent so designed that the stronger the wind blows the more resistant the tent becomes, air survey equipment, high-altitude stoves and radio equipment.

3. The Flyers' and Explorers' Globe, bearing the signatures and showing the routes of many famous explorers and 'round the world and transatlantic flyers. Those represented include Lindbergh, Post and Gatty, Byrd, Nansen and Wilkins.

4. New York City in maps. From the earliest plan of New Amsterdam to present-day maps illustrating the distribution and classification of buildings, the city's highway, subway and elevated, and railroad terminal systems, its complicated interlacing of power lines and telephone and telegraph offices.

5. Geographical background of the European situation. Maps which illustrate the boundaries in Europe according to language, physical and economic characteristics, religions, major soil regions, and which show political boundaries during five periods of European crisis.

6. Examples of primitive and historical maps, including an Eskimo relief map carved in driftwood and a Turkish map of the Atlantic Ocean and its coasts (1513) believed to be based on a lost map by Columbus and published at the suggestion of the late President Kemal Ataturk of Turkey.

7. Mapping by photography. Illustrations of modern methods and special mechanical equipment developed at the American Geographical Society for doing survey work by airplane and camera in a fraction of the time required by the older methods. A typical survey of an unmapped, almost unknown country, northernmost Labrador. Illustration of the work and details of the functioning of the

new 9-lens aerial camera developed by the United States Coast and Geodetic Survey.

8. The "Millionth Map" of Hispanic America. A project which has occupied the society for eighteen years—the mapping of the whole of Hispanic America to conform to the standard of the International Map of the World on the scale of 1: 1,000,000. This is the largest map project ever undertaken by a private organization and is now nearly complete.

ARCHEOLOGICAL EXCAVATIONS OF THE FIELD MUSEUM OF NATURAL HISTORY

THE first exhibition of archeological material excavated from the ruins of villages inhabited a thousand years ago and more by the prehistoric basket-maker Indians of Southwestern Colorado was opened on May 26 at the Field Museum of Natural History. The objects were recovered by the 1938 Field Museum Archeological Expedition under the direction of Dr. Paul S. Martin, chief curator of anthropology. Dr. Martin and associated archeologists have spent months in intensive study of this material, and most of it, dug up in fragments, has had to be carefully pieced together in preparation for exhibition. The results of the research, both in the field and in the museum laboratories, are shortly to be published in an illustrated book to be issued by Field Museum Press.

There is exhibited a painting by Arthur G. Rueckert showing the restoration of a basket-maker village as it must have appeared when it was inhabited by American aboriginals about A.D. 860. There are examples of rare red-on-orange pottery of a type unknown to archeologists until a few years ago. This dates from about A.D. 700, or possibly earlier, and it has not yet been determined where it was first made. The use of designs in red on orange contravenes accepted traditions. Usually the pottery is plain gray, or is marked with black designs of a simple nature on a gray background. In addition to the pottery, the display includes other objects used in the daily lives of the basket-maker Indians, who probably perished before white men reached this continent. Included are various kinds of tools and implements made of bone and stone—awls, axes, mauls, corn-grinding mills and ornaments. Difficulties in making the restoration are described by Dr. Martin as follows:

> Since these villages had been exposed to the rains and snows of more than a thousand years before the museum expedition arrived on the scene, all the perishable objects—such as basketry, cloth, sandals, matting and wooden materials—have long since rotted away. Thus the archeologist is confronted with the problem of reconstructing history from only three classes of objects: pottery, bone and stone. Imagine how trying it would be for an archeologist a thousand years from to-day to have to piece together a complete story of the complex civilization of America from only broken dishes, rusty tools of which he did not know the uses, and empty tin cans. In spite of this difficulty, however, we have managed to reconstruct a reasonably clear chronology of events in basket-maker times.

The expedition uncovered a number of great kivas or underground ceremonial chambers, including the largest structure of the type ever found—83 feet in diameter. These, together with subterranean pit-houses, barracks-like rows of surface houses and other architectural types, are restored in the painting of the village.

Eight summers have been spent in the excavation of the basket-maker sites in Colorado. The ninth expedition, sponsored by Stanley Field, president of the museum, planned to resume the work early this month. This time operations will be concentrated upon the excavation of some ruins near Glenwood, New Mexico. The new sites belong to what is known as the Mogollon culture, and investigations will be conducted to determine whether or not there was a cultural connection between the Mogollon and basket-maker cultures.

JOINT MEETING OF THE ROYAL METEOROLOGICAL SOCIETY AND THE AMERICAN METEOROLOGICAL SOCIETY

A JOINT meeting of the Royal Meteorological Society and the American Meteorological Society will be held in Toronto, Canada, on August 28 and 29.

Professor D. Brunt, F.R.S., of the Imperial College of Science and Technology, and Dr. W. Elsasser, of the California Institute of Technology, will read papers on radiation.

Dr. J. Bjerknes, of Bergen, Norway; Dr. H. R. Byers, of the United States Weather Bureau; Professor C.-G. Rossby, assistant chief of the Weather Bureau, and Dr. S. Petterssen, of the Massachusetts Institute of Technology, will read papers on the extra-tropical cyclone. Ample time will be provided for the discussion of these papers.

There will be a visit to the David Dunlap Observatory, and a dinner will be given by the University of Toronto to the delegates and their ladies.

Accommodation will be provided at one of the university residences, at $1.00 per day, and meals may be obtained nearby.

The sessions will be held in the Royal Ontario Museum, and the meeting will close in time for delegates to join the excursion of the American Geophysical Union from Kingston, Ont., on the morning of August 30.

GRANT FOR PHILADELPHIA TO AID AMATEUR STUDIES AND ADULT EDUCATION IN SCIENCE

THE Carnegie Corporation of New York has made a grant to the American Philosophical Society to undertake a broad survey of adult education in science, using the Philadelphia region as an experimental area. The purpose of the investigation will be to promote knowledge in the sciences and in scientific methods through new means and to encourage the participation of amateurs.

To guide this experiment the American Philosophical Society has appointed a committee on organization, including Edwin G. Conklin, executive vice-president of the society and professor emeritus of biology at Princeton University, as chairman; Anton J. Carlson, physiologist, the University of Chicago; Karl K. Darrow, the Bell Telephone Laboratories; Luther P. Eisenhart, professor of mathematics, Princeton University; C. E. Kenneth Mees, director of research, the Eastman Kodak Company; Harlow Shapley, director of the Harvard Observatory; W. F. G. Swann, director of the Bartol Research Foundation of the Franklin Institute; Harold C. Urey, professor of chemistry, Columbia University, and Roland S. Morris, president of the American Philosophical Society.

The survey will be conducted by an executive staff of scientific consultants. It will study educational programs already in progress in many institutions and will also determine the contribution made by some one hundred and eighty amateur organizations in the Philadelphia area, including astronomers, telescope makers, natural history and hiking clubs, photographic groups and others. Special emphasis will be placed on the participation of persons in discussion forums, laboratory courses, museum tours and field trips.

A unique feature of the plan is the cooperation to be secured from local institutions and organizations, including the Philadelphia Board of Public Education, more than sixteen colleges and universities, the Franklin Institute, the Academy of Natural Sciences, the Wagner Free Institute of Science, the Museum of the University of Pennsylvania, the Delaware Valley Ornithologists Club, the Rittenhouse Astronomical Society and many others.

The Executive Staff of the Committee on Education and Participation in Science has as its chairman Roland S. Morris and as its executive secretary in charge of the survey W. Stephen Thomas, recently director of education of the Academy of Natural Sciences. The members of the staff who will act as consultants in their various fields are: Roger Conant, zoology, curator of the Philadelphia Zoological Gardens; Dr. John M. Fogg, Jr., botany, University of Pennsylvania; Dr. Serge A. Korff, physics and astronomy, Bartol Research Foundation, and Dr. Edward E. Wildman, science education, of the Philadelphia Board of Public Education.

SCIENTIFIC NOTES AND NEWS

THE American Association for the Advancement of Science will hold its hundred and fourth meeting at Milwaukee from June 19 to June 24, under the presidency of Professor Walter B. Cannon, of Harvard University. With it will meet a number of affiliated societies. The full preliminary program of the meeting, compiled by the permanent secretary, was published in the issue of SCIENCE for May 26.

THE list of birthday honors of the King of England includes a knighthood conferred on Dr. Owen Richardson, professor of physics at the University of London, from 1906 to 1914 professor of physics at Princeton University.

THE Belgian Society of Tropical Medicine, which has charge of health work in the Belgian Congo, has elected Dr. Alfred C. Reed, director of the Institute of Tropical Medicine of the University of California, a corresponding member.

DR. SELMAN A. WAKSMAN, microbiologist of the New Jersey Agricultural Experiment Station, has been elected a foreign member of the Royal Swedish Academy of Agriculture.

AT the annual alumni reunion dinner of the Massachusetts Institute of Technology, Dr. Dugald C. Jackson, professor emeritus, formerly head of the department of engineering, was made an honorary member of the Alumni Association.

AT the commencement exercises of the University of Missouri the degree of doctor of laws was conferred on Dr. Earl Raymond Hedrick, provost of the University of California at Los Angeles and vice-president of the university.

STEVENS INSTITUTE OF TECHNOLOGY, at its sixty-seventh commencement on June 10, conferred the honorary degree of doctor of engineering on William S. Knudsen, of Detroit, president of the General Motors Corporation; on Ole Singstad, chief engineer of the New York City Tunnel Authority; on William LeRoy Emmet, of Schenectady, N. Y., who has been associated with the General Electric Company since 1887, and on Alexander Graham Christie, professor of mechanical engineering at the Johns Hopkins University and president of the American Society of Mechanical Engineers. Mr. Knudsen delivered the address to the graduating class.

AT the forty-fifth annual commencement of the North Dakota Agricultural College, the honorary degree of doctor of agriculture was conferred on Professor C. B. Waldron, professor of landscape gardening and forestry, formerly professor of horticulture and dean of the School of Agriculture of the college, and upon Professor H. L. Bolley, botanist and plant pathologist of the College Experiment Station.

PROFESSOR H. B. WALKER, head of the division of agricultural engineering at Davis of the University of California, will be presented at the thirty-third annual meeting to be held in St. Paul, Minnesota, from June 19 to 22 with the John Deere Medal of the American Society of Agricultural Engineers in recognition of his achievements in "the application of science and art to the soil."

The seventieth birthday of Dr. H. H. Dixon, professor of botany at Trinity College, Dublin, was celebrated by the presentation of a congratulatory address. Nearly three hundred names were appended, including those of his colleagues, of representatives of the colleges of Eire and Northern Ireland, of the universities of Great Britain and of many European and American universities. The presentation was made by the provost, who spoke of Professor Dixon's occupancy of the chair of botany, to which he succeeded thirty-five years ago, on the retirement of the late Professor Wright.

Dr. W. D. Cairns, professor of mathematics at Oberlin College for the past forty years, retires this month. His address as secretary-treasurer of the Mathematical Association of America remains as previously, Oberlin, Ohio.

At the University of Colorado, following the retirement of Professor Francis Ramaley, Dr. Gordon Alexander has been promoted to a professorship and will become head of the department of biology, and Dr. Edna Louise Johnson has been promoted to a professorship in biology. Dr. Ramaley will continue at the university as editor of publications.

Dr. Paul Bartsch, curator of the Division of Mollusks, Cenozoic Invertebrates, Helminths and Corals of the U. S. National Museum and since 1899 professor of zoology at the George Washington University, will retire this month from his chair at the university with the title emeritus.

Dr. John Rathbone Oliver, having reached the age of sixty-seven years, is retiring as associate in the history of medicine at the Johns Hopkins University.

Dr. Alfred Newton Richards, professor of pharmacology at the University of Pennsylvania, was elected on June 5 vice-president of the university in charge of medical affairs to fill the vacancy occasioned by the death of Dr. Alfred Stengel on April 10. He will take office on July 1. Dr. Richards will retain his professorship of pharmacology both in the School of Medicine and in the Graduate School of Medicine.

Dr. Dirk Brouwer has been promoted to an associate professorship of astronomy at Yale University.

At the University of London, Professor W. E. Le Gros Clark, since 1934 professor of anatomy in the University of Oxford, has been appointed as from October 1 to the chair of anatomy tenable at University College. Dr. Samuel Nevin has been appointed to the chair of pathology of mental disease tenable at the Maudsley Hospital. He will take up his work in September.

The Board of Managers of the Wistar Institute of Anatomy and Biology have announced the following elections and new appointments: *President*, Dr. Esmond R. Long, director of the Henry Phipps Institute and professor of pathology at the University of Pennsylvania; *Members of the Board of Managers*, Dr. Alfred Newton Richards, professor of pharmacology at the University of Pennsylvania and vice-president in charge of medical affairs, and William H. DuBarry, vice-president and assistant to the president; *Executive Director*, Dr. Edmond J. Farris, associate in anatomy in charge of operations, the Wistar Institute.

Joseph R. Slevin, curator of herpetology in the California Academy of Sciences, arrived on May 9 in Chiriqui Province, Panama, where he plans to spend several months collecting reptiles and amphibians. This is a continuation of work previously undertaken in the Central American region.

Dr. Ernst A. Bessey, professor of botany and dean of the Graduate School at the Michigan State College, East Lansing, has leave of absence for the next college year to become visiting professor of botany at the University of Hawaii during the occupancy of the Bishop professorship at Yale University by Professor Harold St. John. Dr. Bessey will leave in August, returning in about a year.

Dr. Max Bergmann, member of the Rockefeller Institute for Medical Research, delivered the Edward Gamaliel Janeway lecture at Mount Sinai Hospital, New York City, on May 16. His subject was "Some Biological Aspects of Protein Chemistry."

At the annual Harlow Brooks medical program of the Washington Square Medical Society on April 20 Dr. Louis F. Bishop opened the session with an address entitled "Reminiscences of Dr. Harlow Brooks" and Dr. Lewellys F. Barker, Baltimore, delivered the memorial lecture on "The Diagnosis and Treatment of Vitamin Deficiencies."

Dean Frank C. Whitmore, of the Pennsylvania State College, on May 19 gave the sixty-sixth Barnwell address at the Central High School of Philadelphia. Others who have spoken in this series since 1922 are Edwin E. Slosson, Michael I. Pupin, Henry Fairfield Osborn, William Beebe, Wm. F. G. Swann, Clyde Fisher, Karl Taylor Compton, Aleš Hrdlička, Isaiah Bowman and Edwin G. Conklin.

Dr. Aleš Hrdlička, of the U. S. National Museum, lectured at University College, London, on May 31 and June 1. The subjects of the lectures were "The Present Status of Our Views on Human Evolution" and "The Racial Fallacies and Realities of European Peoples."

Dr. George W. Lewis, director of aeronautical research of the National Advisory Committee for Aeronautics of the United States, delivered in the lecture hall of the British Institute of Mechanical Engineers on May 24 the twenty-seventh Wilbur Wright memorial lecture entitled "Some Modern Methods of Research in the Problems of Flight."

The fifth International Congress for the Unity of Science will be held at Harvard University from September 3 to 9. Rooms will be available at $1.25 per day per person. Arrangements can be made through Dr. W. Van O. Quine, Harvard University, Cambridge, Mass. Contributions to the congress are as follows: Donors, $25.00 upwards; active members, $5.00; students and relatives of members, $1.50. All who would like to receive later notices of the congress should send their names to Professor Charles W. Morris, University of Chicago.

At the annual meeting of the Midwestern Psychological Association held recently at the University of Nebraska, the following new officers for the year 1939–40 were announced: *President*, J. P. Guilford, University of Nebraska; *Secretary-Treasurer*, Robert H. Seashore, Northwestern University, and *Member of the Council*, N. R. F. Maier, University of Michigan. The fifteenth annual meeting will be held on May 3 and 4, 1940, at the University of Chicago.

The House of Representatives on May 24 completed Congressional action on a bill to authorize the construction of two new vessels for the Coast and Geodetic Survey at a cost of $1,425,000. The bill carries no appropriation.

Through the courtesy of Mrs. Margaret W. Biddle the California Institute of Technology has been given the chemical library of Professor Henry Chalmers Biddle, formerly dean of the College of Pharmacy of the University of California. The library consists mainly of books and journals dealing with organic chemistry.

The Rockefeller Foundation has appropriated for the Johns Hopkins Medical School a ten-year grant of $350,000 to establish a department of preventive medicine.

Dr. Robert S. Carroll, founder, owner and medical director of Highland Hospital for nervous and mental disorders at Asheville, N. C., has presented the hospital to Duke University, Durham, to be developed as the therapeutic unit of a new department of psychiatry. If at any time in the future the university decides that operation of the hospital in Asheville is not practicable, the property and equipment may be disposed of, but the proceeds therefrom must be used for the department. Dr. Carroll will remain the medical director of the hospital for five years, during which time a gradual interchange of personnel between the institutions will be effected.

According to an announcement printed in the *Journal* of the American Medical Association, research on cancer at the University of Wisconsin will be centralized in a new building now in process of construction. Funds amounting to about $240,000 have been provided for the building by a special bequest, by a contribution from the Wisconsin Alumni Research Foundation and by a PWA grant of $108,000. It will be 102 feet long and 50 feet wide and will be connected with the Memorial Service Institutes of the university and the Wisconsin General Hospital. Two floors will be devoted to biologic research, one to x-ray diagnosis and the first floor to radiologic research and treatment. The new building can not offer space to all the work on cancer of the departments of zoology, plant pathology, agricultural chemistry, physics, chemistry and various departments of the medical school, but it will have conference rooms and will serve as a clearing house to unify the varied activities. In the Wisconsin General Hospital cancer patients from all parts of the state are received, making all types of the disease accessible to research workers. The entire development is being directed by a committee of the Graduate School consisting of Dr. William S. Middleton, dean of the Medical School, *chairman;* Dr. Edwin B. Fred, dean of the Graduate School, and Dr. Michael F. Guyer, professor of zoology. Dr. Walter J. Meek, professor of physiology and associate dean of the Medical School, is chairman of the building committee.

The preparation of a new "Nomenclator Zoologicus" is now approaching completion. It is estimated that the work will comprise some 225,000 entries, of which about 5,000 appear to have been omitted from all previous publications of this character. It is proposed to publish the work in 4 volumes of nearly 1,000 pages each, which it is hoped it will be possible to issue at intervals of about six months. The Zoological Society of London has borne the cost of preparation (approximately £1,800), but the council of the society does not feel justified in incurring further expenditure, which would involve an additional £3,600. However, with the aid of various grants from outside sources, the editor, Dr. Sheffield Neave, has himself now been able to arrange for the printing and publication of the work.

DISCUSSION

PACIFIC ENTOMOLOGICAL SURVEY

This note has been prepared to clarify the meaning of the term "Pacific Entomological Survey" and thus make unnecessary the confusion indicated in correspondence and printed papers. The survey was organized in Honolulu in 1926 through a cooperative agreement, for a five-year period, 1927–1932, between Bernice P. Bishop Museum, the Hawaiian Sugar Planters' Experiment Station and the Association of Hawaiian Pineapple Canners, and had for its purpose "collecting, mounting, sorting and identifying insects of the Pacific islands (including Hawaii), preparing lists and descriptions for publication and publishing the same." As the director of the survey, the committee in charge appointed C. F. Baker, dean and director of the College of Agriculture, University of the Philippines. On the death of Dr. Baker on July 28, 1927, E. P. Mumford, Commonwealth fellow, University of California, was chosen as his successor, and in association with A. M. Adamson, now professor of entomology at the Imperial College of Tropical Agriculture (Trinidad), and local assistants, collected insects in the Marquesas Islands (January, 1929, to April, 1930; Adamson collected in the Society Islands, September to December, 1928). At the close of the period of cooperative agreement (1932), the organization was extended for one year (1933) and then disbanded with the understanding that papers based on these collections in preparation by specialists in entomology would be published by Bishop Museum and credited to the Pacific Entomological Survey (most of these papers have been issued as Bulletins 98, 133, 114, 142, in press). Since 1933, field studies of the insects of the Pacific Islands have been continued, organized and financed by institutions in Hawaii. In excess of 100,000 specimens have been brought to Bishop Museum from the Mangarevan Islands, Austral Islands, Tuamotu Archipelago, Rapa, Society Islands, Equatorial Islands, etc., in 1934; Micronesia in 1935–1936; Guam in 1936; Fiji, New Zealand in 1937; Fiji in 1938.

Some time after the official termination of the Pacific Entomological Survey and while studies of the Marquesan insects were in the process of publication in Honolulu, there was organized, and the name registered, a "Pacific Entomological Survey" under the directorship of E. P. Mumford, with headquarters at Oxford. Unfortunately, the name applied to the new "Survey" is the same as that long in use in Hawaii, and to avoid misunderstanding it is appropriate to note that the two organizations are entirely unrelated in present personnel, finance and program; that the new "Survey" is distinct from the survey organized in Hawaii, and has no control over the collections made in the Marquesas and Society Islands by Mumford, Adamson, Whitten, Tauraa and Le Bronnec during the period 1928–1933, nor over the publications resulting from their study. All correspondence pertinent to the original survey should be addressed to Bernice P. Bishop Museum, Honolulu.

C. Montague Cooke, Jr.
Harold L. Lyon
Bishop Museum
C. E. Pemberton
Hawaiian Sugar Planters' Experiment Station
Royal N. Chapman
University of Hawaii

DIURNAL CYCLE OF HEAT RESISTANCE IN PLANTS

A daily cycle of heat resistance in plants that does not appear to have been reported in the literature has been discovered in the several species of field crops studied including corn, wheat, barley, sorghum and alfalfa.

In these studies the daily maximum resistance to heat was attained by plants at about mid-day and continued during the afternoon. The minimum resistance prevailed early in the morning. Resistance to heat increased in plants when they were exposed to light and decreased in the absence of light. One hour of light, following normal darkness of night, was long enough for plants to acquire a measurable and, in some cases, a marked amount of resistance to heat. Ordinarily plants reached their daily maximum heat resistance within four hours after exposure to daylight following normal night. Plants exposed to electric light during the night were more resistant to heat in early morning than those that had been in the dark during the night.

The loss of heat resistance in plants when exposed to darkness was slower than the gain of resistance in the presence of light.

Most of the investigations were made with young plants, although corn and sorghum were tested also in the flowering stage. Exposure to high temperature for five hours was sufficient clearly to indicate differential resistance. The degree of temperature required to distinguish differences in heat resistance depended upon the species and the condition of the plants.

The following data are presented as illustrations of the experimental results that have been obtained in these studies. Young wheat plants, grown in the greenhouse in January, when tested at 122° F. for five hours beginning at 8 A.M., were injured 68 per cent. as indicated by the proportion of tissue that was killed. In similar tests beginning at 1 P.M. the injury was 18 per cent. Young barley plants which received no morning light preceding the test were injured 84 per cent., while those that had been exposed to the forenoon light preceding the test were injured 21 per cent. Wheat plants which had been three feet below a 200-watt Mazda light during the night were injured 24 per cent. when tested for five hours at 120° F., whereas similar plants that had been in the dark during the night were injured 70 per cent. by the treatment. Wheat that had been kept in the dark during the night and forenoon was injured 95 per cent. compared with 15 per cent. injury to plants that had been treated in the same way except that they were exposed to daylight for one hour immediately before the test. Corn plants in some cases exhibited increased resistance to heat following exposure to light for less than one hour. Wheat that had been in daylight throughout the forenoon was injured 10 per cent. by heat, whereas the plants that were prepared in the same way except for being in darkness one hour immediately preceding the test were injured 30 per cent. Sorghum in the heading stage was injured less by exposure to 150° F. for five hours beginning at 1 P.M. than to 140° F. for the same length of time beginning at 8 A.M.

The photosynthetic production of organic material suggests itself as an explanation for the increased resistance of plants to heat. It appears, however, that the amount of organic material that might be manufactured during the short exposure to light, which is needed to bring about a marked increase in resistance, would probably be insufficient to account for so much change in resistance. Perhaps a photochemical change or some other influence of light which can be induced quickly may be responsible for the increased resistance of plants to heat when they are exposed to light.

Investigations seeking an explanation for the phenomenon resulting in a daily cycle of heat resistance in plants are being continued.

H. H. LAUDE
KANSAS AGRICULTURAL EXPERIMENT STATION

NIEVES PENITENTES NEAR BOSTON, MASSACHUSETTS

ON March 11, 12 and 13, approximately 11 inches of snow fell in the Greater Boston area. This, together with what had already fallen, made 14.2 inches of snow. For ten days following this storm, the temperature remained below freezing much of the time (Table 1). During this period the humidity was continuously low and there were several clear days (Table 1).

As these conditions are ideal for the formation of nieves penitentes, it is not surprising that on March 21, 22 and 23 the writer observed larger and more perfectly formed nieves than he had ever before seen around Boston. These features are usually found on the snow fields of lofty mountains. They have been described from the Himalayas,[1] Sierra Nevada,[2] Kilimanjaro[3] and also from the Andes,[4] where apparently they reach their greatest size and most perfect development.

TABLE 1

U. S. WEATHER BUREAU, BOSTON, MASSACHUSETTS

Date	Max. temp. F°	Mean temp. F°	Humidity at noon	Sunshine
March 14 ...	38°	30°	59	clear
" 15 ...	38°	30°	74	cloudy
" 16 ...	45°	36°	95	cloudy
" 17 ...	38°	32°	47	clear
" 18 ...	35°	29°	52	partly cloudy
" 19 ...	31°	24°	35	clear
" 20 ...	40°	32°	64	cloudy
" 21 ...	36°	30°	54	clear
" 22 ...	35°	28°	44	clear
" 23 ...	41°	31°	40	clear
" 24 ...	58°	40°	43	clear

As is shown in A of Fig. 1, a great many were approximately one foot high. They ranged, however, from a fraction of an inch to 2 feet in height. They were usually separated by pits, although some of the smaller ones were separated by east-west trenches. The pinnacles pointed toward the south, and the back slope (north facing) of many was approximately 36 degrees. Some of the pinnacles were separated from each other by bare ground, the result of complete melting and evaporation of the snow between them (B of Fig. 1). Many of the snow banks, which were originally of irregular shape, had cliffs two and three feet high on the south side and a flat slope on the north. As March 24 was a warm day with the temperature almost continually above 32 degrees (Table 1), much melting took place and the nieves were largely destroyed.

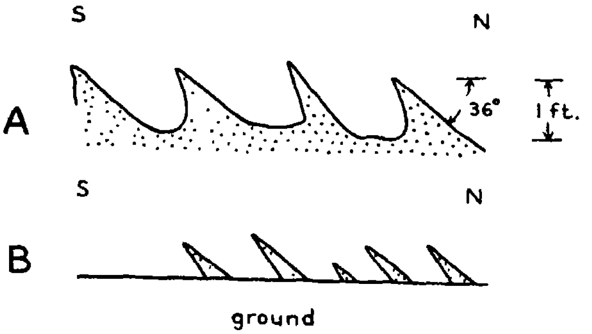

FIG. 1. Diagrammatic sketch of nieves penitentes near Boston, Mass. A—Pinnacles separated by snow. B—Pinnacles separated by bare ground.

It is generally agreed that the nieves are produced by the radiant heat of the sun. For their best development there must be a prolonged period with the temperature below freezing, low humidity and strong sunshine, together with an abundance of clear snow with surface irregularities. As these conditions are found as a rule only at high altitudes, the nieves penitentes are rare at or near sea level. The direction and angle of inclination of the pinnacles is a function of latitude. North of the equator they point south, south of the equator they point north, while on the equator they are vertical.

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[1] W. H. Workman, *Zeitschrift für Gletscherkunde*, 3: 241–270, 1909.

[2] F. E. Matthes, Trans. Amer. Geophy. Union, 15th annual meeting: 380–385, 1934.

[3] F. Jaeger, *Zeitschrift der Gesellschaft für Erdkunde*, No. 2: 101–103, 1908.

[4] H. Meyer, *Zeitschrift der Gesellschaft für Erdkunde*, No. 2: 98–101, 1908. See also R. Hauthal, *Zeitschrift der Gesellschaft für Erdkunde*, No. 2: 95–98, 1908.

Their unusual size was due in part to the fact that they were formed in March. On March 21 Boston receives 1.3 times as much heat from the sun as it does on December 21. Assuming the necessary temperature conditions, low humidity and sunshine, it would take approximately 1.3 times as long to form nieves of any given size in December as in March. Although insolation would be still stronger in April, it is almost impossible to have snow and freezing conditions for more than a few days at this time. Hence large nieves are not to be expected in Boston in April.

It was estimated from the number and size of the pinnacles that as much as ¼ of this snow-fall wasted away by evaporation. If this condition was general over Massachusetts and New England, the loss of melt water due to this evaporation must have been considerable.

Robert L. Nichols

Tufts College

LANGUAGE DIFFICULTY

American scientists, linguistically provincial, often have an apprehension about going to Europe to confer or conduct research in the scientific laboratories because of the "language difficulty." During the past year I had the occasion to converse with the directors (or persons in charge) of 66 biological field stations in 16 European countries (including Russia). In my experience, two thirds of the scientists interviewed spoke understandable English (universally, in Denmark, Sweden and the Netherlands), and of those who did not speak English, 80 per cent. spoke French, and the others German. There are good assurances, therefore, that if an American scientist does go to Europe on business, he can make himself understood scientifically, although there is no evidence that the percentage of political understanding is that high.

Homer A. Jack

Cornell University

BOOKS AND LITERATURE

BIOLOGY

General Biology. A Textbook for College Students. By Perry D. Strausbaugh and Bernal R. Weimer. xi + 555 pp. 284 figs., including 13 colored plates. John Wiley and Sons, Inc., New York. 1938. $3.75.

To the writing of text-books on general biology there seems to be no end. The urge undoubtedly reflects the growing trend of formal instruction away from general botany and zoology toward general biology. This trend has been marked during the past two decades in America. It is noted in the high schools as well as in the colleges and universities. In fact, it probably began in the secondary schools. Such a trend is a phase of the larger movement toward general science courses. And the latter is a phase of the still larger movement toward the orientation course, the general college and what have you. Many teachers of science feel that all these movements tend to debase science. They tend to force higher educational interests to bow to more and more secondary and even elementary objectives. Maybe so, maybe not. At any rate the general biology course is with us. It will be with us for a long time. We must accept the challenge and set out to solve the associated problems. These are about the first major problems related to biological teaching that we have faced for a third of a century. Will the older generation of botanists and zoologists in our universities forget their prejudices and background, dig into a new batch of meristem and do this important job that society demands of the schools? That is the real challenge.

Literally dozens of authors have given us new books in the hope that they would supply an important aid in the above evolutionary movement. The most of such books are poor. Some are downright bad, or almost silly. Some are so extremely dilute as to challenge only the "man on the street." Others are so complex and technical as to stump a Nobel prize winner in biology. Some are so broad and general as to embrace the universe. Others are so restricted and specialized as to be worthless for this job. Many such books are of value merely to throw light upon the narrow point of view and limited experience of the authors. Others only emphasize the author's specialties.

It seems to us that the new book by Strausbaugh and Weimer more nearly represents the proper point of view and more nearly furnishes the material for a good course in introductory biology for colleges and universities than any book we have seen. The book is fairly well balanced. That alone is a real accomplishment. The pedagogy and style are fitted to the undergraduate student. Fundamental phenomena and conceptions are not completely buried in technicalities.

The physics and chemics of biology are extremely simplified, but that is necessary for hosts of students who have never studied physics or chemistry even in high school. The fundamental aspects of the structure, function and life history of organisms constitute major threads for the presentation. The classification of organisms and the major groups of the two kingdoms are given adequate and discriminative space and treatment. The brevity of treatment of such broad topics as variation, evolution, genetics, environmental relations will disappoint specialists in those phases. But the same reaction will follow the examination of the book by special workers in other lines of research. We simply must let ourselves down to the level of the audience which presents itself for instruction in *general* biology. Eight out of every ten of that group have never taken any other course in science. Less than that number will ever take additional courses in the more specialized sciences. The authors of this book seem to have caught the significance of this situation and have tried to select their material and to treat it so as to fit the audience. It is apparently with a keen understanding of the limitations of their audience that the authors assumed this important task. A constant emphasis upon the essential and the usable features of general biology clearly reflects this point of view.

There are several unfortunate blunders and lesser errors in the book. We need not enumerate them here. These may all be corrected in a second printing. We do not favor the inclusion of lists of "selected references," as is generally done after each chapter in the book. Mighty few students even look *at* them, much less look them *up*. In fact little time is available for this extra work. The value of such inclusions is to the teacher only. Few teachers ever use such values. The etymology and definition of many terms and words are given, as a rule, where they are first used. A formal glossary is omitted. Our experience teaches us, however, that numerous students use and benefit from a carefully prepared glossary. The book is well manufactured. The typography is well selected for the student and teacher. Many of the plain figures are new, generally well done and of great value. The colored plates are certainly welcome.

On the whole this book is admirable for a two-semester course. It should go a long way to aid teachers and administrators to solve the difficult problems associated with the presentation of so general a topic in the curriculum of higher education. We are using it with success.

RAYMOND J. POOL

UNIVERSITY OF NEBRASKA

SEDIMENTARY PETROGRAPHY

Manual of Sedimentary Petrography. W. C. KRUMBEIN and F. J. PETTIJOHN. 549 + xiv pp., 265 figs. D. Appleton-Century Company, New York, London, 1938. Price, $6.50.

UNTIL recently, petrographers have neglected the study of the sedimentary rocks, as they were considered uninteresting and it was believed that their study would lead to few results of general interest. However, in the last two decades interest in these rocks has grown rapidly and now sedimentary petrography is an active and well-developed science. It is actively contributing to the precise correlation of strata; to our knowledge of diastrophism, the location and character of old land masses, the source of the materials of the sediments, the former climatic conditions and many other problems.

The excellent book under review shows how far the new science has developed; in some respects its methods are already more quantitative than are those used in the study of the igneous rocks. As stated in the introduction, "The purpose of the book is to present theories and methods of examining sediments, from the field sampling to the final graphic and statistical analysis."

The first part by Krumbein discusses the collection and preparation of samples, the principles, methods and graphic presentation of mechanical analyses, statistical methods as applied to the data of sedimentary rocks and orientation analyses of sediments. The second part by Pettijohn treats of the shape and surface textures of grains; preparation of samples for mineral analyses, such as disaggregation and clarification of grains; separation methods by heavy liquids, the electromagnet and other methods; optical methods; mineral description and determinative tables; mineral frequencies; chemical methods; and the mass properties of sediments, such as color, density and porosity. The final chapter deals with equipment, reference books, etc.

The book is clearly written and well organized; it covers its field admirably and includes the latest developments in a rapidly progressing science. It should become a widely used text and reference book.

ESPER S. LARSEN, JR.

HARVARD UNIVERSITY

SOCIETIES AND MEETINGS

SPECIAL RESEARCH CONFERENCES ON CHEMISTRY

THREE research conferences on chemistry have been organized by Dr. Neil E. Gordon, secretary of the Section on Chemistry, which will be held at Gibson Island, Maryland, between July 10 and July 28, under the auspices of the American Association for the Advancement of Science. These conferences follow a similar conference held last summer in the same place that proved to be very successful.

In organizing these special research conferences, Dr. Gordon has initiated a kind of meeting that is entirely new and that promises to be effective in promoting the interests of science. For this reason the officers of the association have given this experiment their approval. It is quite possible that there are other kinds of conferences, meetings or field trips that the association might sponsor or in which it might participate to the advantage of science. Like science itself, the association should not be static but always experimenting and alert for new ways of advancing science and our civilization.

The programs of the conferences at Gibson Island are as follows:

RESINOUS POLYMERS

(July 10–14)

L. H. Baekeland, *Honorary Chairman;* Howard L. Bender, *Chairman*

July 10. “Introduction,” by L. H. Baekeland, Bakelite Corporation, Bloomfield, N. J.
“The Physical Viewpoint of Resinous Particles as to Size and Linkage,” by Howard L. Bender, Bakelite Corporation, Bloomfield, N. J.
Leader of discussion of preceding paper, Tom Midgley, Ethyl Gasoline Corporation, Detroit, Mich.
Dinner at 7:00 P.M. in honor of Dr. Baekeland.

July 11. “The Infusible Resinous State,” by R. H. Kienle, The Calco Chemical Company, Inc., Bound Brook, N. J.
“Conditions for Infusibility,” by S. S. Kistler, Norton Company, Worcester, Mass.

July 12. “The Resinous Vinyl Compounds,” by S. D. Douglas, Carbide and Carbon Chemicals Corporation
“Polystyrene,” by Ivy Allen, Bakelite Corporation, Bloomfield, N. J.

July 13. “The Structure of Some Vinyl Polymers,” by C. S. Marvel, University of Illinois, Urbana, Ill.
“Spectroscopy and Resin Structure,” by R. B. Barnes, American Cyanamid Company, Stamford, Conn.

July 14. “Electronic Structure and the Behavior of Cellulose Compounds,” by G. M. Kline, National Bureau of Standards, Washington, D. C.
“Viscosity and Constitution of High Molecular Weight Substances,” by P. J. Flory, University of Cincinnati, Cincinnati, Ohio

VITAMINS

(July 17–21)

C. G. King, *Chairman*

July 17. “Problems and Policies in Relation to the Vitamins in the Enforcement of the Federal Food, Drug, and Cosmetic Act,” by E. M. Nelson, U. S. Department of Agriculture, Washington, D. C.

July 18. “The Biochemical Reactions of Vitamin C,” by C. G. King, University of Pittsburgh, Pittsburgh, Pa.
“Vitamin B_1 (Thiamin) Analysis, Assays and Specific Functions,” by R. R. Williams, Bell Telephone Laboratories, New York, N. Y.

July 19. “The Identity and Function of the Newer Members of the Vitamin B Group,” by C. A. Elvehjem, University of Wisconsin, Madison, Wisconsin
“The Hydrogen Carrier Function of the Vitamins, Limited to Riboflavin and the Nicotinic Acid Amide Containing Coenzymes,” by C. V. Smythe, University of Pennsylvania, Philadelphia, Pa.

July 20. “Vitamin A,” by K. Hickman and E. Le B. Gray, Eastman Kodak Company, Rochester, New York
“Physiological Functions of the Vitamin A,” by George Wald, Harvard University, Cambridge, Mass.

July 21. “Vitamin D,” by C. E. Bills, Mead Johnson and Company

RELATION OF STRUCTURE TO PHYSIOLOGICAL ACTION

(July 24–28)

Walter H. Hartung, *Chairman*

July 24. “Local Anaesthetics,” by Arthur J. Hill, Yale University, New Haven, Conn.

July 25. “Sulfanilamide Derivatives,” by The Calco Chemical Company, Inc., Bound Brook, N. J.

July 26. “Relationships Between Physiological Action and Constitution in a Series of Morphine Derivatives and Synthetic Analgesics,” by Lyndon F. Small and Erich Mosettig, University of Virginia, University, Va.

July 27. “Certain Significant Physico-Chemical Factors in Cell-Drug Reaction,” by M. E. Krahl and G. H. A. Clowes, The Lilly Research Laboratories, Indianapolis, Ind.
“Hypnotics,” by W. G. Bywater, Parke, Davis and Company, Detroit, Mich.

July 28. “The Carcinogenic Activity, Structure and Chemical Properties of Polynuclear Aromatic Hydrocarbons,” by L. F. Fieser, Harvard University, Cambridge, Mass.

The meetings begin at 10 o'clock, with one or two formal papers outlining the fields of research and directing attention to the unsolved problems. Since not more than two papers are given on any one day, it is possible to have the discussion of the papers not limited in any way. The program will also permit time for certain recreational features which the island affords.

Since the accommodations on the island are limited, it is advisable to make reservations in advance. For reservations or further information, application should be made to the secretary, Neil E. Gordon, Central College, Fayette, Mo.

F. R. MOULTON

REPORTS

GRANTS FOR RESEARCH OF THE GEOLOGICAL SOCIETY OF AMERICA

TWENTY-EIGHT grants in support of special research projects were authorized by the council of the Geological Society of America at the April meeting, as follows:

Ralph E. Grim, Illinois State Geological Survey, Urbana. Dr. Grim's well-known exhaustive studies of clays of Illinois have developed a strong interest in the genesis and evolution of the several minerals of the clay groups. In the main, however, materials available to him until now were from the Pennsylvania underclays. With this grant from the society he will have the opportunity to apply his researches to large collections of recent marine clays taken from the floor of the Pacific, $1,800.

Charles A. Anderson, University of California, Berkeley, and Charles W. Merriam, Cornell University, Ithaca, N. Y. Dr. Anderson and Dr. Merriam will spend five to six weeks during the coming summer in the Roberts Mountains, one of the Basin Ranges of western Nevada, rechecking the distribution of Tertiary volcanics and their relationship to the later faulting. An important key to the later structural history of the central Great Basin may be disclosed. Stock-like bodies and sills of alaskite porphyry cutting the Paleozoic formations in the southern portion of the range present a number of interesting problems of petrogenesis to be worked out. $600.

Louis L. Ray, Harvard University, and J. Fred Smith, Jr., Texas Agricultural and Mechanical College. Dr. Ray and Dr. Smith plan to spend ten weeks in the Moreno Valley in the Sangre de Cristo Mountains of northern New Mexico on a study of the tectonic history of the vicinity. This is considered a critical area for the study of the orogenic history of the southern Rocky Mountains. $650.

S. A. Berthiaume, Cornell University, Ithaca, N. Y. Dr. Berthiaume will go to Diamond and White Pine mountains of east-central Nevada to make a detailed study of the late Paleozoic stratigraphy of, and establish a typical section for, that part of the Great Basin. His work will contribute to our knowledge of the late Paleozoic physical conditions, the structure and volcanic history of the Great Basin, and, it is hoped, may disclose an identifiable flora in the white pine shade in which fragmentary plant remains are known. $250.

Ralph W. Chaney, University of California, Berkeley. Dr. Chaney will assemble all the available data on the character and occurrence of late Tertiary vegetation in western America. This is expected to fill out a little-known chapter of floral history. It will have a critical bearing on the interpretation of later Tertiary vertebrates and invertebrates and will assist in the correlation of several of the terrestrial formations of the region. $600.

N. H. Darton, U. S. Geological Survey, Washington. Dr. Darton will continue his field studies of the overlap relations of the Tertiary and Cretaceous formations in eastern Maryland and Virginia. During the course of the study to date several very significant stratigraphic features in the Eocene succession which throw considerable light on the structure and overlap relations have been made manifest. $450.

Victor T. Allen, St. Louis University. Professor Allen will devote several weeks to field work on the west side of the Great Valley of California collecting samples of Eocene white clays and sands. The samples will be studied petrographically, chemically and by x-ray technique, and comparisons will be made with results already in hand from the Ione formation on the east side of the valley. The research is an attempt to answer the question as to whether during the Eocene Sierran minerals were carried across what is now the Great Valley or whether anauxite clays formed at nearly the same time on two widely separated terranes. The results will be a contribution to the physiographic and climatic conditions during the Eocene. $500.

Robert P. Sharp, University of Illinois, Urbana. Dr. Sharp will go to the Ruby-East Humboldt Range of Nevada for two months of field work in completing his study of the boundary structures and Cenozoic history of this Basin Range. The study is expected to contribute to the relations between pre-Tertiary and Basin Range structures. Furthermore, in the southern part of the range the formations are unmetamorphosed, and it will be possible to establish the stratigraphy and thereby contribute to studies in the northern part, where igneous intrusions have cut the formation to pieces. $310.

F. J. Pettijohn, University of Chicago. Professor Pettijohn will continue his study of the lithology and stratigraphy of the early pre-Cambrian sediments in the Thunder Lake region of Ontario. He expects to spend three or four weeks in the field on a special study of the occurrence of calcareous concretions and limy beds and to make special collections for petrographic and chemical analyses. The record of concretions in the early pre-Cambrian is scanty, and Professor Pettijohn plans to contribute data on these to support the doctrine of uniform operation of geological processes throughout geologic time. $175.

Curtis J. Hesse, Texas Agricultural and Mechanical College. Dr. Hesse is to study a collection of fossil vertebrates from the Gulf Coast of Texas. His report on this collection will provide a means of correlating the marine Miocene invertebrates of the Gulf Coast with the fresh-water Tertiary of the mid-continent and allied faunas of Florida. $500.

Henry C. Stetson, Harvard University. Dr. Stetson's work with the Woods Hole Oceanographic Institution during the past two years has included the taking of about fifty cores from the continental slope and in the Atlantic basin by means of the "Piggot gun." The study of the cores is contributing to our knowledge of the Pleistocene history of the Atlantic basin and of the conditions of deposition on the slope and in the canyons. The grant is to furnish spare parts for the "gun" in order that operations need not be interrupted by inevitable losses. $215.

John W. Wells, Ohio State University. Dr. Wells and Dr. T. Wayland Vaughan are completing a revision of the madreporarian hexacorals. Since 1884, when the last compilation was made, a considerable volume of data has accumulated concerning the morphology, classification, ecology and geologic distribution of this group, which has played an important role in the formation of coral reefs since Triassic time. The monograph will represent an intensive investigation of original type material both in this country and in Europe and will present a unified outline of present knowledge, paleontologic and zoologic, of this group. $200.

Richard Foster Flint, Yale University. Professor Flint will spend five weeks in an investigation of the emerged Pleistocene marine features of southwestern Newfoundland. The study will lead to a better understanding of the crustal deformation related to glacial unloading in northeastern North America. The research will contribute to the project to be undertaken by Professors Twenhofel and MacClintock on the physiography and glaciology of the interior and will tie in directly with that on strandline study to be undertaken in Labrador by Professor V. Tanner. $845.

Kenneth E. Caster, University of Cincinnati. Dr. Caster's grant is to enable him to complete his catalogue of the North American Devonian Pelecypoda types. $500.

Paul F. Kerr, Columbia University. Professor Kerr plans to spend about six weeks in the tungsten-bearing area of southern Idaho, Nevada, northwestern Arizona and southeastern California, visiting localities previously studied during the course of the past six years as well as others not yet examined. Following necessary laboratory studies a comprehensive report on the tungsten mineralization in the Basin Range region will be prepared. $1,510.

Edward C. H. Lammers, Washington and Lee University, Lexington, Va. Professor Lammers will spend two and a half months in the southern part of the Beartooth Range continuing his structural studies of the past three field seasons. He wishes to determine the amount of coincidence between Laramide and pre-Cambrian structures in order to evaluate the importance of pre-Cambrian zones of weakness in controlling the Laramide deformation of this typical Rocky Mountain uplift. $565.

Maurice Ewing, Lehigh University, Bethlehem, Pa. Professor Ewing will continue his geophysical studies of the emerged and submerged Atlantic coastal plain. The researches of the past three years consist of the measurement of the depth of bedrock across the coastal plain, the shelf and into the oceanic basin. It is hoped that they will clarify the fundamental differences between continents and ocean basins, answer the question of the continuation of continental geologic structures into ocean basins, and give data on the permanence of ocean basins. The work planned under this grant will cover measurements in shallow water at Long Island, Barnegat Bay, Cape May and off the eastern shore of Maryland. $1,200.

Charles Deiss, Montana State University, Missoula. Professor Deiss will spend six weeks in southern Alberta and British Columbia in continuation of his revision of the Cambrian in the northwestern states and in the southern part of the Canadian Rockies. This work carried on since 1931 has contributed to the establishment of a usable standard Cambrian time scale for North America and to the paleogeography and sedimentation in the Cordilleran region during Cambrian time. $540.

Fred B. Phleger, Jr., Amherst College, Amherst, Mass. Dr. Phleger is to continue his study of the Foraminifera in cores obtained by means of the "Piggot gun" in the basin of the North Atlantic Ocean. His researches are contributing to our knowledge of the distribution of cold- and warm-water areas during the Pleistocene and Recent epochs, of the depth and areal distribution of living Foraminifera, and of the rate of sedimentation in the ocean basin. $600.

Girard Wheeler, Rutgers University, New Brunswick, N. J. Dr. Wheeler is planning to spend several weeks at Jeptha Knob in Kentucky, extending his study of the structure and stratigraphy. Trenching at strategic points near the base is expected to disclose whether certain dipping strata are due to landsliding or to late Ordovician deformation. Other trenches near the top are expected to disclose whether the surface below the Silurian capping is an angular unconformity. Fossils will be collected for later determination and check on the stratigraphy. $150.

Max Demorest, University of North Dakota, Grand Forks. Professor Demorest will devote two months visiting active glaciers in the northern Rockies, the Cascades and the Canadian Rockies. He will study the structure and flow of glacier ice by means of a modification of the technique of petrofabric analysis. Oriented specimens will be cut and observed in the field. Other specimens of glacier ice will be shipped for laboratory testing. $600.

Marland P. Billings, Harvard University. Professor Billings will devote the summer of 1939 to field work in the Presidential Range, New Hampshire, continuing a special investigation of the changes in chemical composition that have affected high-grade metamorphic rocks. At present there is the suggestion that certain stratigraphic units have undergone slight chemical change, while others have been very susceptible. $500.

Willard H. Parsons, Hamilton College, Clinton, N. Y. Dr. Parsons will go to the Deer Creek-McLeod area in southern Montana to complete a study of the eruptive and intrusive rocks of the Stillwater-Boulder River area. He expects, among other things, to discover the loci of origin in the Deer Creek volcanics and to determine whether or not the Deer Creek igneous rocks were produced during a minor orogenic episode foreshadowing the main Beartooth thrusting. His work will be a contribution to the relation of volcanic activity to the Beartooth thrusting. $400.

J. Harlan Johnson, Colorado School of Mines, Golden. Professor Johnson is to examine Permian algal limestones of Colorado and New Mexico to obtain data on the origin and conditions of deposition as well as descriptions of the lime-secreting algae. $225.

George W. Bain, Amherst College, Amherst, Mass.

Professor Bain will spend six weeks at Marble, Colorado, investigating the fabric of the Treasury Mountain granite and its roof rocks. This study is expected to demonstrate the effect of recrystallization upon petrofabric of quartz, calcite and mica in a variety of rocks, the relation of fabric and grain stability to distance from the intrusive, the areal distribution of strain around a plutonic intrusive and the relationship between contact metasomatism and strains. Data on strains in the granite and the adjacent roof may be expected to yield data bearing upon viscosity of magmas. $300.

Charles C. Mook, American Museum of Natural History, New York, N. Y. Dr. Mook will continue the work on his monograph on the Fossil Crocodilia of the World. This work has been under way for a number of years and will be brought to completion during the year. $1,500.

David Griggs, Jefferson Physical Laboratory, Harvard University. Dr. Griggs's investigation of the deformation of rocks by low stresses acting over long periods of time has been going on for two years. The laws of dry deformation have already been outlined. New experiments on specimens deformed while immersed in solutions show marked differences in behavior. New "creep testers" provided for under this grant will permit further investigation of recrystallization flow. $1,200.

Horace G. Richards, New Jersey State Museum, Trenton. Dr. Richards will join forces with Professor H. H. Hess, of Princeton University, on an expedition to the Island of Margarita off the eastern Venezuelan coast, there to collect and study Pleistocene and Recent mollusks. His work will be of immediate value to Professor Hess in his studies of the very large negative gravity anomalies of the vicinity and will contribute further knowledge of the paleogeography of the Caribbean region. $300.

SPECIAL ARTICLES

ON THE PRESENCE OF AZOTOBACTER AGILIS IN AMERICA

Beijerinck[1] created the genus *Azotobacter* for the non-symbiotic nitrogen-fixing aerobic bacteria discovered by him in 1901. Two species were suggested; namely, *Azotobacter chroococcum,* a soil organism, and *Azotobacter agilis,* isolated from water. Lipman,[2,3] in America, described two additional species: *Azotobacter Vinelandii* and *Azotobacter Beijerinckii.* The former is related to *Az. agilis* by the formation of a greenish pigment, while the latter is similar in certain characters to *Az. chroococcum.* All four species are recognized at the present time. In addition, other species reported in the literature are *Azotobacter Woodstownii* by Lipman[3] and *Azotobacter vitreum* by Löhnis and Westermann.[4] These, however, generally are not recognized as well-defined species.

Of all the above *Az. chroococcum* is considered the most typical species of the group, and apparently it has world-wide distribution in soil. *Az. Vinelandii* and *Az. Beijerinckii* have been reported also as present in soil, although not so frequently as the former species. It was first believed that the presence of *Az. agilis* was restricted to the canal water of Delft, Holland, from which the original isolation was made by Beijerinck. The Beijerinck strain being lost, Kluyver and van Reenen[5] isolated an organism identical with *Az. agilis* excepting that there was a lack of pigment formation. Later, Kluyver and van den Bout[6] isolated a pigment-forming strain, and considering it typical of *Az. agilis,* they named the previous isolation *Azotobacter agilis* var. *atypica.*

Recently, the extensive investigation of Winogradsky[7] reported the isolation of this species from surface waters in France. Many characteristics useful in the identification of the species were included in this publication. This isolation, together with the present report, indicates that *Az. agilis* may be distributed more widely than was supposed previously.

In the present investigation, begun in early July of 1938, the technique of Winogradsky was followed using several samples of surface water in 100 cc amounts of different origins at Madison, Wisconsin, and, later, from San Francisco, California. In addition to the original medium recommended by Winogradsky, in which ethyl alcohol is the source of carbon, a slight modification of this was included in which Fe citrate was substituted for Fe chloride.

As shown in Table 1 five samples of water and one sample of sewage effluent were positive out of twenty-two samples examined. The advantage of the modified medium is shown in samples 1, 3 and 5, in which growth occurred only in the modified medium and also in samples 2 and 4, in which cases growth occurred first in the modified medium. Positive samples were characterized by a peculiar purple or violet coloration, especially in the modified medium.

The strains isolated although similar, may be divided into two groups. The strains isolated from lake water are characterized by the lack of pigment and scanty growth in solid mediums, and the production of a

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[1] M. W. Beijerinck, *Centralbl. f. Bakt.,* II Abt., 7: 561–582, 1901.

[2] J. G. Lipman, N. J. Agr. Exp. Sta. Ann. Report, 24: 217–285, 1903.

[3] *Ibid.,* 25: 237–289, 1904.

[4] F. Löhnis and T. Westermann, *Centralbl. f. Bakt.,* II Abt., 22: 234–254, 1909.

[5] A. J. Kluyver and W. J. van Reenen, *Archiv f. Mikrobiol.,* 4: 280–300, 1933.

[6] A. J. Kluyver and B. T. van den Bout, *Archiv f. Mikrobiol.,* 7: 261, 1936.

[7] S. Winogradsky, *Ann. Inst. Pasteur,* 60: 351–400, 1938.

TABLE 1

COMPARATIVE ENRICHMENTS FOR *Azotobacter agilis* WITH WINOGRADSKY'S AND MODIFIED MEDIUMS

No.	Sources of the water	Original W. medium	Modified medium	Observations
1	Lake Mendota (Madison, Wisconsin) sample No. 1	–	+	....
2	Lake Mendota (Madison, Wisconsin) sample No. 2	+	+	First growth in modif. medium
3	Lake Mendota (Madison, Wisconsin) sample No. 3	–	+	....
4	Sewage effluent (Madison, Wisconsin)	+	+	First growth in modif. medium
5	Lower Crystal Spring Reservoir (San Francisco, Cal.)	–	+	....
6	San Andres Reservoir (San Francisco, Cal.)	+	+	....

Total number of samples examined for the presence of *Az. agilis*: 22.

faint gold or purple pigment in liquid mediums depending on the nature of the carbon source. In contrast to these, the strains isolated from sewage produced a definitely greenish pigment and grew better in agar mediums. Pigment production in liquid mediums was stronger than in the other group of cultures. The strains of both groups are very motile, and in general the morphological and physiological characters agree with those of the descriptions by the previous investigators. The size of the cells is 2.4–2.8 × 2.5–4.5 μ (taken from pictures originally magnified 200 ×). The cultures used for measurement were grown on Winogradsky's medium with 1 per cent. agar and 0.5 per cent. ethyl alcohol, and a small amount of calcium carbonate. No cultures grew with the use of mannite as a source of carbon, either in liquid or in solid mediums.

For comparison a culture of *Az. Vinelandii* from the Department of Agricultural Bacteriology of the University of Wisconsin was included in this study. Morphologically it differs from *Az. agilis* strains by having elongated cells (1.4–1.6 × 2.5–3.5 μ), usually in pairs, and it is less actively motile. In contrast to the *Az. agilis* the strain of *Az. Vinelandii* grew readily on both solid and liquid mediums with mannite as a source of carbon, producing a greenish fluorescent pigment.

The author wishes to express his gratitude to the Guggenheim Foundation, which granted the study; to Dr. E. B. Fred, dean of the Graduate School, University of Wisconsin, for the facilities in the Department of Agricultural Bacteriology; to Dr. Elizabeth McCoy and L. Gee, of this department, for several samples of water included in the study; to Dr. K. F. Meyer, director of the Hooper Foundation, University of California, also for laboratory facilities; to Dr. C. B. van Niel, the Hopkins Marine Station, Stanford University, to whom the findings were submitted for criticism, and to Dr. L. S. McClung, the Hooper Foundation, for aid received in the preparation of the present report.

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LIVER EXTRACT AS A SUBSTITUTE FOR SERUM IN THE CULTURE MEDIUM FOR ENDAMOEBA HISTOLYTICA[1]

THE first practical method for the cultivation of *Endamoeba histolytica* was published by Boeck and Drbohlav[2] in 1925. The medium consisted of a solid egg slant overlaid with a liquid composed of eight parts sterile Locke's solution and one part of sterile human blood serum. The following year Dobell and Laidlaw[3] used horse serum instead of human serum in the liquid portion of the medium and demonstrated that the addition of sterile rice starch produced more abundant growth of the amoebae and prolonged the life of the cultures, thus requiring less frequent transplants. This medium is used extensively at the present time in the cultivation of *E. histolytica.* Although many suggestions for the improvement of this medium have been made, they have consisted of changes only in the solid portion of the medium. The liquid portion of the medium has consisted in all cases of dilutions of human or animal serum or egg albumen, the most widely used being horse serum-Ringer (1–6). Numerous substitutes have been tested, notably by Cleveland and Collier,[4] but without success.

During the past six months we have been using a 0.5 per cent. solution of liver extract in an 0.85 per cent. solution of sodium chloride as a substitute for horse serum-Ringer. The results obtained have been fully as good as with the serum medium, and the advantages of liver extract in both experimental and diagnostic work are many.

The liver extract which we have used most extensively is Lilly's liver extract No. 343, which is employed in the treatment of pernicious anemia.[5] The powdered commercial product is dissolved in normal saline and sterilized in an autoclave at 15 pounds pressure for 30 minutes. The solution need not be filtered, as there is very little sediment. The solution of liver extract is then added to the sterile solid medium together with a small amount of sterile rice flour. The medium is then tested for sterility by incubating for 24 hours, and is stored in the refrigerator until used.

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[1] Assisted by a grant from the Division of Medical Sciences of The Rockefeller Foundation.

[2] W. C. Boeck and J. Drbohlav, *Amer. Jour. Hyg.*, 5: 371–407, 1925.

[3] C. Dobell and P. P. Laidlaw, *Parasitology*, 18: 283–318, 1926.

[4] L. R. Cleveland and J. Collier, *Amer. Jour. Hyg.*, 12: 606–613, 1930.

[5] Kindly furnished for experimental purposes by Eli Lilly and Company.

We have experimented with several other materials beside whole egg-Ringer for the solid portion of the medium, such as Cleveland and Collier's liver infusion agar, plain agar, plain agar made up in 0.5 per cent. liver extract and Loeffler's blood serum. The best results have been obtained with whole egg and with Loeffler's serum. The other materials have not produced good growth. It is interesting that Cleveland and Collier's liver infusion agar, which produces excellent growth when overlaid with horse serum-Ringer, gave very poor growth when overlaid with liver extract.

Various dilutions of the liver extract have been used, ranging from 0.2 to 2.0 per cent. The best results have been obtained with the 0.5 per cent. solution. We have also found that the addition of horse serum to the liver extract solution in varying dilutions does not produce any better growth than the liver extract solution alone.

In addition to Lilly's liver extract No. 343 we have tested the following preparations and have found them equally serviceable in 0.5 per cent. dilution: Lederle's "Solution Liver Extract Parenteral," Lederle's "Liver and Iron" in powder form, Wilson's "Liver Extract" solution with 0.5 per cent. phenol and Valentine's "Solution Liver Extract."

Approximately six months ago four strains of *E. histolytica,* which were being maintained in the egg-horse serum-Ringer medium, were transferred to the egg-liver extract-saline medium. These four strains had been under cultivation in our laboratory for a period of from two to six years. The cultural characteristics of these four strains have remained the same in the liver medium as in the horse serum medium. Cyst production is equally good in the two media, in both tube and flask cultures. At the present time we are using the liver extract medium in all our experimental work.

The use of 0.5 per cent. liver extract in the cultivation of *E. histolytica* directly from stool specimens also has certain advantages. We have never failed to initiate growth from a fresh stool in which cysts or motile forms of *E. histolytica* have been found by microscopic examination, and the growth has been uniformly more abundant after 24 hours than in the horse serum medium. *Blastocystis hominis,* which often interferes with cultures in the horse serum-Ringer medium, does not multiply in the liver extract medium.

We have not studied extensively the use of liver extract in the cultivation of the other intestinal amoebae of man. Attempts to cultivate *E. coli* and *Endolimax nana* have failed. Several cultures of both *Trichomonas hominis* and *Chilomastix mesnili* have been obtained from stools and have been maintained until discarded. A few attempts to cultivate *Giardia lamblia* from cysts have failed.

Other advantages of the liver extract over horse or human serum are that it can be resterilized several times without injury, it is inexpensive, it is available as a commercial preparation, it is easily prepared for use, and it requires much less aseptic manipulation than horse or human serum.

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ADRENAL ATROPHY AND SENESCENCE PRODUCED BY A VITAMIN DEFICIENCY

IN the course of experiments with young rats on the symptoms produced by deficiency of the factors in the vitamin B_2 complex[1] it was noted that the fur of black and brown rats gradually turned gray, coarse and lifeless when they were deprived of the filtrate factor or factors. The growth of these animals was usually subnormal and the graying developed only after eight to sixteen weeks of depletion, when the animals were twelve to twenty weeks old.

If the mothers were deprived of the factor from the day of the birth of the young the young rats developed the graying as early as eight weeks of age. If the mothers were deprived of the factor from the day of mating the litters were of normal size and weight, but none could be reared to weaning age. Filtrate factor deficiency is decidedly more damaging to milk production than is deficiency in either vitamin B_6 or riboflavin.

When the gray rats are kept in the deficient state for several months there occurs a peculiar sloughing of spots and patches of the skin, sometimes an inch or more in diameter with lazy ulcers resulting, which remain unchanged for months. Crystalline vitamin B_6 in large doses has no curative effect on these ulcers, but administration of concentrates of the filtrate factor brings about rapid healing. These ulcers are reminiscent of the "leg ulcers" of nutritional origin reported from the tropics.

The graying and all accompanying changes can be cured in a few weeks by administration of filtrate factor concentrates or, the graying at least, by injection of relatively large doses of adrenal cortex extract. The symptoms are not relieved by additional B_1, B_6, riboflavin, copper or iron, or by nicotinic acid or epinephrin. The effect of thyroxin is still in doubt.

Histological study of the skin, hair, adrenals and gonads of these animals have revealed striking and consistent atrophy of the adrenals, loss of elastic layer of the skin, failure of spermatogenesis, atrophy of hair follicles. Intermediate stages in this degeneration have been detected paralleling the graying and regenerative stages studied during recovery.

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[1] Morgan, Cook and Davison, *Jour. Nutr.,* 15: 27, 1938.

We have also been able to turn the fur of one black guinea pig completely gray by a diet deficient in this factor and have produced graying of hair about the mouths of two young Boston bull pups.

Apparently many of the physical changes of senescence have been produced in these animals in the course of a few weeks by depriving them of the unknown dietary factor which affects particularly the function of the adrenal cortex.

The curative concentrates have been made from yeast, rice bran and liver. Whether the filtrate factor in question is the same as the anti-chick pellagra filtrate factor of Lepkovsky, Jukes and Krause[2] is not at present known.

A full report of these experiments will appear elsewhere.[3]

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BACTERIAL LEAF-SPOT DISEASES[1]

AN investigation has been made of the leaf-spot of Pennsylvania cigar-leaf tobacco, commonly known as "wildfire." Evidence obtained in these laboratories indicates that the organism associated with the leaf-spot, *Phytomonas tabaca,* is a transitory physiological adaptation of the common saprophyte, *Pseudomonas fluorescens.* This organism, in various physiological adaptations, is found in large numbers on normal tobacco. It is apparent from the data obtained in these investigations that all Pennsylvania cigar-leaf tobacco is exposed to this organism throughout the growing and ripening period and that infection in the field is due not to the mere presence of the organism, which is ubiquitous, but to improper host nutrition.

Single cell isolations of various adaptations of the organism have been the subject of physiological and serological studies. The particular adaptation, or what might be termed by the plant pathologist "relative virulence" has been found to vary greatly according to the source of the isolation. Distinct physiological characteristics have been found to be typical of these various isolates. Rapid changes may be made in the laboratory at will, both in the direction of increased and decreased virulence. Serologically, it appears that the "virulence" of the organism is associated with the specific nature and amount of the capsular material of the cell. Although the particular adaptation of the organism is probably related to severity and rapid spread of infection in those cases in which the tobacco plant is suffering from improper nutrition, the evidence indicates on the other hand that the most "virulent" adaptations of the organism are unable to cause economic loss in those cases in which the nutrition of the plant is satisfactory, other things being equal.

The normal tobacco plant of the cigar-filler type is very resistant to infection of economic severity during the growing season. Leaves of such a plant ordinarily contain at maturity between 3 and 4 per cent. nitrogen and between 4 and 5 per cent. potassium. Changing agricultural practices of the past quarter century have resulted in the general production of an abnormal tobacco from the standpoint of nitrogen and potassium content.

Investigations have shown that, contrary to the opinions expressed in publications by other workers, it is not the exact nitrogen level within reasonable limits that is important but the ratio of nitrogen to certain minerals within the plant and, of extreme importance, the stage in which high nitrogen uptake occurs.

Any condition which leads to the accumulation in the plant of a greater quantity of nitrogen than potassium results in poor quality and susceptibility to leaf spot troubles. It is not to be inferred from this that potassium is the only other element which must be available to the plant in order to insure quality and disease resistance. Potassium is, however, the element needed in greatest amount and apparently most frequently deficient in the Pennsylvania area.

It is not during the period of active growth but during the period of ripening that faulty agricultural practices may lead to the greatest susceptibility to leaf-spot. Our investigations have shown that, regardless of the nutrition of the plant prior to this period, the uptake of significant quantities of nitrogen during the ripening period results in an appreciable lowering of the normal resistance of the plant to wildfire. In Pennsylvania certain practices are necessary which accentuate the abnormal condition brought about by significant nitrogen uptake during ripening and greatly increase the susceptibility of those plants taking up large quantities of nitrogen during the ripening period. These include "topping" and "suckering" which take from the plant the possibility of utilizing large amounts of nitrogen at this period in the proliferation of new tissue. It is significant that wildfire was not a problem in Pennsylvania a number of years ago when agricultural practice precluded the possibility of any appreciable ammonification and nitrification at the ripening period.

Practices in Pennsylvania which have been found to be largely responsible for the severity of leaf-spot infections are, in the order of their importance: (1) the incorporation of large quantities of organic nitrogen in the tobacco soils, a portion of which in some seasons may remain to be ammonified during the ripening period; (2) the use of too much nitrogen and insufficient potash in the fertilization treatment; (3) the use of excessive amounts of lime, which interferes with the normal potassium uptake of the plant; and (4) in some cases poor tilth, which also interferes with mineral uptake.

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[2] Lepkovsky, Jukes and Krause, *Jour. Biol. Chem.*, 115: 557, 1936.

[3] We acknowledge with gratitude help in the interpretation of the tissue changes from Dr. Jesse Carr, of the Department of Pathology, University of California School of Medicine.

[1] Authorized for publication on March 27, 1939, as paper No. 898 in the journal series of the Pennsylvania Agricultural Experiment Station.

Practices tending to produce a normal resistant plant of high quality and good yield are as follows: (1) the use of another crop such as corn between clover and tobacco in the rotation to reduce the amount of organic nitrogen in the soil; (2) preliminary rotting of all manure used on tobacco in order to avoid the risk of adding large quantities of available energy to the soil; (3) the use of liberal applications of well-rotted manure to improve tilth and aid potassium uptake; (4) the use of suitable applications of a well-balanced fertilizer in which the amount of organic nitrogen is less than the amount of inorganic nitrogen; and (5) suitable cultivation to insure maximum uptake of potassium and other essential nutrient materials.

In the course of these investigations it was considered advisable to study physiologically and serologically several other members of the genus *Phytomonas*, associated with leaf-spots. The data obtained indicate that other members of this genus studied are merely temporary physiological adaptations of *Pseudomonas fluorescens*. A brief study of predisposing factors in these diseases further emphasizes the similarity of bacterial leaf-spot diseases and the relation of the pathological condition to the improper nitrogen-mineral nutrition of the host. The results of these investigations will be published in detail in a Bulletin of the Pennsylvania Agricultural Experiment Station.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SYSTEM OF INDEXING 2×2 INCH SLIDES

THE handling of microfilm (35 mm) used in research and teaching can be divided into three major phases: (1) the filing of negatives; (2) the filing and indexing of positive or negative film-strip reprints of library material; (3) the filing and indexing of 2×2 inch monochrome or natural color slides for use in teaching or in research where color must be recorded.

Considerable interest has been shown in the use of film-strip,[1,2] particularly with reference to its bibliographic service. However, its value for teaching is distinctly limited by the inflexible sequence of the images on the film and the technical difficulties in using it for projection in natural colors.

The use of film-slides (2″×2″) has received less consideration in scientific journals, perhaps due to the fact that such slides do not serve a new purpose, but merely constitute a means of doing an old job better. Film mounted between cover glasses is little subject to injury, and the slides can be rearranged for various purposes by different individuals. They have therefore greater usefulness for longer periods of time than film-strip. As compared with larger sizes of lantern slides, the lower cost, the greater ease of carrying many slides and reduced breakage of the microfilm slides makes them a very valuable aid to teaching and research. Since the results of research can never be utilized to the maximum extent unless they are adequately exposed through effective teaching, it is apparent that the use of microfilm slides, particularly those in color, is well worth the consideration of those engaged in either teaching or research.

The cost of film-slides and their greater versatility of arrangement and use ordinarily requires that large departmental or institutional slide collections be used by several individuals. This necessitates a system of filing and indexing which will enable each user to find slides conveniently, not only in his own major field, but in those of his colleagues as well. Usually information concerning the subject illustrated on the slide and its source is required whenever a slide is used.

Several individuals have cooperated in devising a system for filing and indexing slides that effectively meets these requirements and has proven efficient and very useful in this department. The system is divided into three parts: a subject index, a slide file and a negative file. All may be housed in a filing cabinet designed for 3×5 inch cards.

The subject index is the central part of the system and is responsible for its usefulness. A picture of the slide subject (contact print) is attached with dry mounting tissue to the upper left-hand corner of a 3×5 inch card where it may be readily seen in thumbing through the index. The subject is placed in the remaining space at the top of the card. For brevity the major subjects of the index are abbreviated (G—genetics, E—embryology) and followed by a descriptive sub-title. On the rest of the card is recorded the number of the slide represented, the number of the negative from which it was made, bibliographic ref-

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[1] Lee R. Dice, SCIENCE, 89: 39, 1939.

[2] Atherton Seidell, SCIENCE, 89: 32, 1939.

erence or other notation concerning the source of the material and descriptive information. The subject headings of the index are patterned after the bibliographic indices of those using the material. Colored cards are used for indexing colored slides, white cards for those in black and white.

Any one wishing a certain slide or one on a specific subject turns to that subject in the card index and chooses, on the basis of the picture and attached information, the slide he wants. He may then quickly draw the slide of that number from the slide file.

The slide file is a numerical arrangement of the slides in each major subject. The file of this department is divided into twelve such major fields. As in the card index the subjects are indicated by letters, the slides by numbers. To find slide G-253 one opens the "genetics" drawer and removes the slide bearing that number on the "thumb mark" placed on the upper right-hand corner of the slide as it goes into the projector.

The slides are filed on edge with the numbers toward the front of the drawer, in wooden troughs 2 inches wide by 1½ inches deep inside. A white card which projects slightly above the slides is placed at intervals of 25 slides and bears the number of the series at that point. The troughs are made in units of two, which fit into a 3 × 5 inch card compartment. Four rows of more than 100 slides each can thus be filed in each of the lower drawers of the cabinet holding the subject index. The bottoms of the troughs are raised above the bottom of the drawer sufficiently to raise the slides to the top of the 3 × 5 inch compartment. To facilitate removal and handling of slides the inside depth of the trough is one-half inch less than the height of a slide.

The negative file is a comparatively inactive file, since it is likely to be used only for duplication of slides or for making prints of the slide subject. Various methods of filing may be utilized.[1] A convenient one has been to cut the film into strips of three negatives each and place them in 3 × 4⅞ inch kraft paper coin envelopes ("bags") which are numbered serially. These envelopes are durable and can be filed in a drawer of the cabinet containing the subject index and slides. (Use of the short length of film has not appeared inconvenient in the enlarger or contact printer used, and when a certain negative is required, unnecessary handling of other negatives is avoided.)

The clerical labor and the printing of photographs necessary for the subject index is well repaid in a large collection by the later saving in time required for finding desired slides and by the fact that several individuals can use the same collection effectively and without confusion. Moreover, the experience in this department shows that slides thus catalogued are more extensively used because of the ease with which the desired material can be found.

W. F. Lamoreux

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Cornell University

LANTERN SLIDES FROM TYPEWRITTEN MATERIAL

The recent note of Carpenter,[1] under the present title, on typing or drawing through white carbon paper onto black paper, to eliminate one step in the photographic process of making white-background slides is useful for certain work, but we have found that another step—that of retyping text material and retracing diagrams through white carbon paper—can be avoided by photographing the material from which slides are to be made onto a contrast grade direct positive film of the type supplied by the Eastman Kodak Company in their "high contrast direct positive film." The result of using this is a positive film (without having to prepare a negative) which can be bound between two standard size slide glasses with a slide mask as usual, effecting a saving in time of preparation.

Charles G. Miller

Berkeley, Calif.

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[1] Science, 89: 372, 1939.

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NORTH AMERICAN RESPONSIBILITIES FOR THE UNIVERSITY, 1934–1954[1]

By Dr. ALAN GREGG

THE ROCKEFELLER FOUNDATION

For the past sixteen years I have had occasion to visit medical schools and institutes of medical research in some thirty countries. In the variety one encounters in such an experience—variety of methods, of purposes and of circumstances—one is reminded of a saying of Oscar Wilde: "When you break the little laws the big laws begin to operate," for out of so many contradictions and differing practices emerge certain underlying principles. I can not forget the first time I saw an Irish jaunting car. My impression was that if that was a vehicle then one could design almost anything for transportation purposes and it might work, for if one sees underlying principles in a great variety of forms the end result is a great sense of freedom to tackle almost any new task.

Now, one question which I should like to ask you this evening is this: Are we prepared here in North America to assume responsibility for the maintenance and continuation of one of the greatest traditions of Western Europe, the university? Everywhere I have gone and seen institutions of higher learning there are traces of that tradition—sometimes strong, sometimes weak, but there is no doubt that in the world of teaching and of scholarship the university as it has developed in Western Europe is the source and the paradigm. How much do we understand of this tradition? If we accept Hegel's definition of freedom as "the recognition of necessity" then are we free to select the best there is in the university tradition and cherish it.

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[1] Presented at the annual banquet of the Federation of Societies for Experimental Biology, Toronto, April 28, 1939.

Of the Tercentenary of Harvard a curious and arresting story is told—as I happen to know quite accurately. In three separate instances European delegates to the Tercentenary remarked privately to their friends: "I came to this celebration with a heavy heart. Our priceless heritage, the university, is in the gravest peril in Europe. But what I have seen here gives me hope again, for I have seen that it can go on in North America." To match this faith, to justify this hope, let us ask ourselves this question, "Are we fully prepared to carry on if need be?" For that may be our greatest task in the next twenty years.

It would be a waste of time to try to appraise the universities in Europe or to attempt to judge their merits compared with our own. Many years ago a student in the Andover Theological Seminary who had fallen in love in the second year found himself but ill prepared for the examination in hagiology. The question posed in the examination was, "Name and describe five of the minor prophets." After much biting of his pencil he wrote: "God forbid that I should discriminate between these pious and holy men." So I shall attempt rather to offer you some of the convictions my years abroad provided regarding phases of European university life which I do not see well developed, nor in some cases indeed even recognized on this side of the Atlantic. Let me speak of things I fear may be lost or weakened and urge you to think of others needed if we are to justify the hope that is placed in us.

Before 1914 we in North America regarded the universities in Europe with earnest respect. Indeed there was admiration—implicit or explicit—and the flattery of imitation. Many of our superior students sought and found in Europe intellectual habit—personal independence, intellectual method—thoroughness and the conviction that there was an opportunity for each to add to the scholarships of the world. Relationships almost filial in their devotion grew up between great teachers and eager Canadian and American disciples. And of peculiar importance and value there spread over Canadian and American university life that wonderful open-mindedness and unselfconscious receptivity which always characterizes ingenuous humility and true modesty. We weren't ashamed to learn nor afraid to try. We had no false pride or narrow loyalties. But our contacts were in the main personal, our admirations individual and the models chosen were from varying systems of university life. It was only rarely that an American or Canadian student was taken into the very heart of institutional guidance and policy-making, there to remain long enough to understand fully the nature of the university as an institution. Such experience on the inside of institutional policy and guidance would have imparted certain values to the younger men—such values as might be worth striving for in the universities in the New World to which they were to return.

From 1914 to 1934 circumstances and attitude have changed. The flow of graduate students to Europe has much diminished where it has not ceased. Europe has had less comparatively to offer: its university facilities often seem niggardly, its professors overloaded and preoccupied and impoverished. Confidence and leadership are not in the air, though the capacity for work and the cultural baggage of the European professor continue to impress the North American visitor. On this side of the Atlantic university buildings, facilities, endowments and teaching loads have increased. We have made some substantial additions to the world's store of knowledge. With one such signal contribution this city—Toronto—is associated. Thus the stage is set for the false conclusion to emerge that Europe can mean but little more to us. Is this the wisest mood?

In this matter of cultural transfer one needs a word which means to translate the function as contrasted with imitate the form. To copy, or to pattern after, or to imitate, all connote attention to form. What is needed is a word that means to secure the transfer of a function not the carrying over of a form. And this is needed to help to make clear this point: It is some of the functions of the European university we could well be taking over, whereas it might be either futile or disastrous to take over their forms. But you are to be spared a new word, for we should be passing now to the consideration of what seems to be lacking in the apparent completeness of the transfer of the functions of the European university to the North American scene. And I must add in these remarks, I am not a xenophile. The word, like the sentiment, is rare these days. I don't wish to seem to belittle what we have nor imply that what is remote is better than what is at hand. But the fact is that the functions discharged by the European universities have shown impressive vitality. They are worth study, and besides that they are our heritage. I want rather to draw attention to what has been called the technique of rejuvenation—to fit functions seen operating elsewhere to our own conditions on this side of the water.

Of all that is worth attention in the European universities, we may have accepted only a part, and of what we have accepted only a part in turn may survive. The better to understand these possible losses it may be well first to examine aspects of the local scene which bear upon our capacity to assimilate and to maintain the functions of the university as it has evolved in the area of its origin.

Higher education in North America has grown in an environment peculiar and in two points at variance with the European milieu. I should suppose that we live in the largest area of homogeneous culture in the world. Wide circulation of books, newspapers, moving pictures, the radio and easy travel reinforce this homogeneity.

When I was in our Paris office friends arriving from America would ask, "Well, how are things in Europe?" Now that is an impossible question, for Europe is too different to be reported upon in its totality, and yet the question indicated the unconscious assumption that any one might have coming from North America that statements could be made for Europe in general as they can for North America. You will recall the French lecturer who, after a whirlwind trip of the United States in which he met many friends and contemporaries, sank exhausted in his cabin of the boat taking him back to Paris, surrounded by twenty-two books sent him by his American friends to read on the voyage home. When the covers were off the books he discovered that seventeen out of the twenty-two were identical copies of the book recommended at that time by the Book-of-the-Month Club.

But this amazing homogeneity results in a kind of self-assured insularity, for there is real difficulty in finding able outsiders or distinguished critics or other persons proceeding from totally different axioms to challenge our uniform conclusions or throw our major assumptions into doubt. By as much as we are so large and so homogeneous our obvious differences are more superficial than they seem. This similarity of view in one area after another is simply not to be found in Europe, and it can hardly be questioned that homogeneity disposes more to emotional belief than reasoned certitude, since those contrasts and contradictions are lacking which arrest the attention and demand explanation and choice.

Furthermore, it may be of value to note that the position of the intellectual in Europe may be affected by the fact that in every European capital there is a great if not the greatest university in the country. In America, in Canada and in Australia the political capital is not the place of a great university nor a center of affairs. And the only partial variant from this observation—London—is easily reached by men from Oxford or Cambridge. And thus American and Canadian universities have grown up without as easy and as close a contact with political and financial leaderships as is characteristic on the European continent. Are there not peculiar risks in such isolation—as well as some advantages?

Another characteristic in the North American scene: Underlying higher education here we have forms of secondary education which prepare our students for advanced work in the universities less adequately than their analogies in Europe. For their objectives and for society generally our secondary schools may do a passable job, but for the purposes of the university the secondary schools in America leave much to be desired.

I have often wondered why this is the case. One of the reasons must be the relative absence of family ambition and pressure upon young people of the secondary school age. I remember on the suburban train out from Paris I used to see a French father and his son of thirteen or fourteen who used that precious twenty-five minutes in a regular and earnest lesson in English. Later in a similar commuter's train out of New York I saw one time a similar father and son, and this time the father was reading the stock reports and the boy was reading the "Funnies." I commented upon this contrast to a neighbor of mine that very day, and he looked gravely disapproving and said: "Oh, I don't believe in that; that's not what I would have done; I believe in being a companion to my boy and I would have been reading the 'Funnies' with him."

Historically, our universities grew out of the colleges. The colleges were in the main sectarian enterprises to produce teachers and preachers. There was more pressure for the graduates, teachers and preachers to be numerous than to be excellent, and this pressure had also a flavor of sectarian competition, and so grew up the tradition that the college professor's moral and religious duty was to *teach,* and this well-nigh to the exclusion of scholarship and participation in self-government or associate living. In some of the colleges to-day there is a measure of sectarian stubbornness, narrowness and pretension which knows no better standard for self-comparison than the record of some nearby rival.

Add to this preoccupation with the teaching load the aura of political and social approval expressed in the phrase "equality of opportunity" and the staggering mass of poorly prepared students which have been crowding the colleges and universities and you have a dilution of scholarship which is no better than oedema. It will "pit on pressure." As in planting trees too close together, the *equality* of opportunity is not as important as the nature of the opportunity and relief from unreasonable circumstances. It is not the equality but the quality of opportunity that counts. Our universities have accepted so huge a burden of teaching that there is a serious discrepancy in many institutions between the tacit understandings on the campus and the explicit claims and purposes in the catalogues.

There is a better test than numbers, than equality of opportunity, than the moral duty of teaching. We should rather judge a university or indeed any form of human association by what kind of a life it permits, encourages and rewards. I submit that all the colleges and all too many of the universities reward the close following of orders and the hard study of assigned work. Before I went to medical school I went down to Johns Hopkins to look around and decide whether I should go there. Quite by chance while I was strolling through the anatomy building one of the teachers stopped me and engaged in what seemed to me a perfectly delightful twenty minutes conversation on the business of being a medical student. I found out later that I had talked with Franklin P. Mall. Just after that conversation I saw in the street a student I had known when we were together at a boys' camp. I taxed him for information about Hopkins. "Oh, it's wonderful," he said, "and what teachers—Welch, Howell, Abel, . . ." And then he added suddenly: "All except one, . . ." "Is that so," I replied, "and who is he?" "Oh, his name is Mall," my young friend replied. "Do you know what he did the very first day in Anatomy? He said, 'Gentlemen, the dissecting rooms are open from nine in the morning till ten at night; I can recommend the three following text-books; there will always be some one there to help you if you get stuck, and when you are ready to take the examination let us know.' Now," continued my young friend, "If you can beat that for a ——— of laziness, you're going some." There was a lad who had done well in a system of close following of orders and hard study of assigned work, but completely at sea when the strategy of his existence was placed on his own shoulders. Strategy is the art of knowing when and on what conditions you will engage your strength. Our college students get too little of it. Their life is one of tactics, and tactics of course is simply the skill, the economy and the grace with which you employ your force when the strategical question is settled. Our secondary schools and our colleges produce a fair tactical product, but our students are immature in questions of strategy, and I would rest my case in this claim by pointing out the existence in many a university catalogue of one phrase, disastrous or funny as you choose, *"obligatory electives."*

Moreover, in our schools and colleges learning by symbols—the spoken and the written word—is encouraged. Its importance is exaggerated because there is another kind of learning, namely, learning by experience. My dogs have no symbols, and yet it is stupid to think they don't know me. Perhaps the unit of this learning by experience is the conditioned reflex, but the summation of these reflexes, experience, is of greater importance than the intellectuals realize. Knowledge from experience gives skill; it gives joy, and it gives courage. Courage may be the thing most required of universities in these next twenty years.

And lastly we are flooded by students, by poorly prepared students. We encourage them by our methods, and our tradition of being teachers foremost has accustomed us to being preoccupied with what we are really giving the students. We are sentimental about it. We give till it hurts—till it hurts the student. Let me read from a letter of a college president I received not long ago: "We are trying to work out therefore the implications of an educational philosophy which places the focus of interest in what is actually happening in and to the minds of individual students on our particular campus." Now, my comment would be that instead of having the teacher's attention on what is going on in the student's mind, why not in the maturer stages of education have the student's attention on what is going on in the teacher's mind? One important qualification to this general statement that we are flooded with students should be made in connection with the medical schools, since the medical schools in North America have sharply limited the number of students admitted. They have limited student numbers not on the basis of teaching by symbols—lectures and reading—but on the basis of the opportunities that can be given their students for experience and learning by experience in laboratories and clinics.

Now may I touch upon what European experience has taught me to want to see more of over here?

First of all, we should be more preoccupied with the social and intellectual climate created by the university—a social and intellectual climate in which the creative powers of scholars will flourish. The Scandinavians, when they build a laboratory, provide specifically a room or two for the emeritus professor. What a wise understanding of what retirement could mean! I do not retire my friends at 65, nor does the counsel and contact with men above that age cease to be valuable to me. There should be more appreciation of the concept of the university as a place where any person's genius for the scholarly life is cherished. The system of dining in hall in the English university has something we can't capture in hurried cafeteria lunches at the Faculty Club. There is a leisureliness and an equality among fellows dining in hall which enables them to estimate and experience each other as human beings. That is precious. How soon will we realize that we could pay more attention to each other and thus to the example we set our students? I remember a clinic that I attended given by Widal. First the student presented the case, haltingly and inaccurately, but nonetheless a fair performance in the light of his immaturity. Then the interne presented the same case with improvements in the information selected, in its fullness and in its accuracy. And then Widal's assistant amplified, refined and corrected the information and placed that particular case of bronchiectasis in a clear and entirely satisfactory light. But then the master, Widal, beginning with the anatomy, the physiology, the bacteriology and the pathology of bronchiectasis, chose just the significant facts from the previous statements and went on to the differential diagnosis, to the nosology of the disease and prognosis and to the indications of where further knowledge is needed. As exposition perhaps it was laborious, repetitive and cumbersome, this turning of four individuals on the same material, but as an example of mastery of subject it was magnificent and not the mastery of a sudden absolute perfection, but, as it were, a graduated mastery, an eminence attainable to any one whose eyes and efforts were turned upward. Perhaps it is this neglect of example that is responsible for the remark of a European professor on returning from a visit to America: "I have never heard from university colleagues so much talk about education and so little about scholarly problems." Now I should expect that perhaps one quarter of the Ph.D.'s in the United States make any subsequent contribution that equals their thesis. That is a serious situation. Our product could well be the quality of our lives together and not merely the qualifications of our graduates to leave us.

It is so strongly in our social tradition to be alert to the encroachments of the few upon the mass that we ignore the depredations of the mass upon an élite. It is almost too delicate a situation to speak of an élite, but I simply mean by that word that rather limited number of men in universities who may wisely be assumed to be their own best taskmasters. I once asked Owen Lattimore what was the Samurai's code. He replied that there was no code, exactly speaking: only this, that a member of the Samurai realizes that whatever he does *is* the standard of behavior for all classes in Japan. The élite exists when capacity, freedom and responsibility are welded together.

The word "freedom" raises many a resonance in university life. One of the shrewdest remarks on that subject is the story of that extraordinary English woman, Gertrude Bell, who knew Arabia so thoroughly that during the Great War she became an emissary of the British Government to various Arab chieftains. To one such she outlined an arrangement, saying something like this: "If you will do so-and-so and so-and-so, the Government will give you full liberty." The Arab chief drew himself up, regarded her with dignity and said: "Madam, may I remind you that liberty is always taken and never given?" It seems to me that if we approach the question of freedom from the point of view of what can be done to secure it our attention can best be devoted to producing an atmosphere of equality.

Equality is the best condition for securing freedom, and whatever helps to make your colleague feel himself your equal is precious to him and to you and to the life of the university. The judicial mind, self-criticism, the readiness to discuss and dispute without dogmatism —and then tolerance, dignity and fair play—all these are exquisitely desirable in order that freedom and variety be given a chance to prove their value. Such a theory of the élite and of equality can be conveyed only by example and experience—lectures, books, exhortations and speeches (including this one) are quite useless. Sometimes I think that our architects should carve above academic entrances a symbol too often forgotten, the mythical animal of the Middle Ages—"the Toad that bears a jewel in his head"—for too often our attitude is captious and picayune; we want perfection in every colleague.

Now I miss the Old World's interest in quality—and their grave expectations of what an élite may be relied upon to do. We speak of graduated thermometers and graduated students—but our graduates are not graduated finely enough. We have been so preoccupied by tending them day by day that no stiff stern measure is set against their performance. We take, compared with Europeans, a motherly interest in their difficulties instead of a fatherly interest in their trials of strength. We reward the élite with distrust and a heavy routine instead of with freedom, expectation and responsibility. Not very long ago a French scholar with no university connections wrote three excellent books in the field of medieval history. In recognition of his ability he was offered a professorship at the Collège de France. He accepted. In late October he called upon a colleague in the Collège to learn a little more of what might be expected of him. After an hour of inconsequential talk he got down to his main inquiry. "Tell me," he said, "what are my duties at the Collège de France?" The reply was, "Ask the janitor. He knows when the rooms are heated, lighted and available. For it is the tradition at the Collège de France to select persons who know how to lead in their fields better than any one else can tell them, and we leave that problem to the men to solve as they see fit."

Now such confidence in superior human beings involves a respect for the individual and a naturalism that are remote from the hire-and-fire atmosphere pervading the college and many a university preoccupied with teaching schedules and processing the student. The professor abroad is selected with more deliberate and thorough discrimination than is yet the common tradition here, and then rewarded with a greater measure of confidence.

I think it was Otto Warburg who told me that if one of the Kaiser Wilhelm Gesellschaft institutes were to be devoted to histology, and if the man chosen to head that institute wished to devote the largest share of his funds to maintaining an elephant from whose patient hide histological specimens could be daily clipped, the general attitude would be one of curiosity and expectation rather than censure and, as the too sadly current idiom has it, of "turning on the heat." I liked a story Professor Barcroft told me of Sir William Hardy: "Hardy told me two years before he died that he was beginning to be interested in the edges of substances. Now Hardy was the kind of individual who, had he lived, would soon oblige somebody to look up the Greek word for edge and add 'ology,' for what Hardy began as an interest he was likely to leave as an accomplished field of study."

There is a certain dignity in the scholar's position in Europe; it gives us all pause. I think it derives from the stability of his situation. I remember once visiting a medical school in Scandinavia. The dean told me that in visiting one of the professors I would see a very neurotic individual. It proved to be true, and when I saw the dean later he said a little quizzically, "I think this man would be what you call in your country 'fired,' isn't it?" I said I thought so. He replied: "We think it is more important to have the professorship inviolate than to have one neurotic professor in one subject, in one school. And," he added, "this tradition makes us more careful when we select professors."

As part of the respect for the individual I wish we could have in this country a larger measure of interest in what could be called the natural history of the creative process. All too rarely does one see acknowledgment of the fact that between periods of creative activity many a man experiences a fallow period. When competitive conditions are exaggerated, this fallow period is coldly denominated "sterility." I think we need sometimes less competition and more encouragement. I do not want to seem sentimental, but honestly so intense during the long winter months is the atmosphere of criticism, and unfavorable criticism, that I sometimes suspect that academic people have to stage a parade before commencement with gowns and regalia and words of praise and honorary degrees, in order to recapture the fragments of their fractured self-regard. As part also of a certain naturalism in the European universities comes their custom of rotating administrative work rather than fixing it upon single individuals. Deanships and rectorships rotate and so rotating furnish political education and administrative experience, and, I might add, sympathy, to a large number of professors. Nor are responsibility and policy left entirely to the older men. At Cambridge, for example, the junior fellows share in the actual governance of the college.

What have we in North America to link the university to society in general, to allow occasional but thorough contemporary evaluation of the universities' work? This is part of what I would call ecology of the university. What are the means of responsible criticism by society at large? The university president? The public relations vice-president or office? The alumni? The regents or trustees? What corresponds in competence and impartiality to the rector for the universities in Sweden? To the British Royal Commission? Or to the University Grants Committee? I've always liked the delicacy of the phrase "University Grants Committee," since it's named not for the donor, which is the government, but for the recipients, the universities. If you doubt the importance of the effect of society on the university, think of the danger that lay in the German universities being so close to the government. The professors were in most cases government employees, and when a political group seized the power of the government the professors were included among the newly acquired possessions. We need further reflection upon the ways in which society can wisely criticize the university and ways in which the university could sense and in some cases implement such criticism.

And now to summarize: The North American scene is characterized by a cultural homogeneity that overwhelms dissent and puts protest upon the defensive. Our universities are divorced from national policy and practical affairs, and this heightens a policy to emphasize learning by symbols rather than by experience and makes the word "academic" an equivalent for "impractical." Our secondary education is inadequate, not for its own objectives, but certainly so for the needs of the university. We overemphasize the importance of teaching and so rob the student of experience and of practice in the strategy of his existence. And, lastly, we have too many students, and this dilutes the quality of university experience for those best qualified to receive it.

I think experience in Europe would make you wish we had emphasis upon the conception of the university as a place where a certain kind of living and example are best realized. You'd find a large measure in Europe of interest of the élite in their responsibilities, an interest in quality, be it ever so rare, and a respect for the individual—his vagaries as well as his excellences. You might come to see, as I have, that there are advantages in the measure of self-direction and self-management of the European universities and in the somewhat austere simplicity of the European scholar's life. You'd return reflecting upon the significance of the university to society and the responsibility and reflective criticism each of the other.

In this huge and homogeneous area of North America I have ventured to call attention to functions I should like to see more of if we in the universities are to be in part responsible for maintaining and cherishing delight in beauty, enjoyment of reason and joy in the skills of living.

SCIENTIFIC EVENTS

VISITATION DAY AT THE GREENWICH OBSERVATORY

THE Board of Visitors of the Greenwich Observatory met on June 3 to receive the report of Dr. Spencer Jones, Astronomer Royal, on the work of the observatory for the year ending April 30.

Attention is called by the London *Times* to the circumstance that in the printed list of visitors the names of professors and others who occupy the position *ex-officio* remain as heretofore, but to the names of those nominated by the Royal Society and the Royal Astronomical Society, six in each case, a date is affixed to show that each is nominated for a period and indicating when that period expires. In this year's list Sir James Jeans and J. H. Reynolds give place to Dr. C. G. Darwin and Dr. R. Stoneley. The name of the late Sir Frank Dyson was printed in the list, and with that exception all the members were present. The invited company numbered nearly four hundred.

The Astronomer Royal, according to the report, is much concerned about the present suitability of Greenwich for certain branches of work, and for that of Abinger in Surrey, to which the magnetic registration of the elements of the earth's magnetic field was transferred in 1924. The electrification of further sections of the Southern Railway has made the removal of the magnetic observations a necessity. Experiments have been made at Selsey which show that the site should be not less than eight miles from any electrified railway, which, if the magnetic observatory is to remain in the south of England, limits the choice to Devon. As to the astronomy, the building developments southward of the observatory from which direction the prevailing winds come and the growth of industries near the river, together with modern developments of street lighting and the extensive use of neon signs, all have their adverse effect on long-exposure photography and in other ways. A table is given of the comparison of sunshine records at Kew and Greenwich which is striking. Twenty-five years ago the average yearly total at Greenwich was 60 hours in excess of Kew's; this has gradually diminished, and now the Greenwich total is less by 160 hours, this being ascribed to loss of register at Greenwich when the sun is low caused by atmospheric impurities.

Dr. Jones closes his report with the remark: "Proposals for the removal of the whole of the astronomical work from Greenwich and of the magnetic work from Abinger to new and more favorable sites are accordingly under consideration."

SURVEY OF THE CENTRAL AND SOUTH PACIFIC OCEAN

PLANS for an extensive scientific survey of the Central and South Pacific Ocean, with a view to solving some of its fundamental problems, have been announced by Dr. Gilbert Grosvenor, president of the National Geographic Society.

Arrangements for the expedition, which will be made on a Coast Guard Cutter, have been reached in consultation with President Roosevelt, Secretary Hull and Under-Secretary Welles, Secretary Morgenthau and Rear Admiral Russell R. Waesche, commandant of the Coast Guard, who are particularly interested in the contributions to navigation, both by water and air, that will be made by the magnetic studies which are a part of the work of the expedition. Concurrently with the carrying on of scientific work, the Coast Guard will make a survey of the present and future needs for navigational aids and radio facilities to assist marine and air commerce.

Professor Wilbur A. Nelson, chairman of the department of geology of the University of Virginia, will be the leader of the expedition. The party will include geophysicists, a geographer, a cartographer and a photographer, provided by the National Geographic Society; specialists on gravity from the U. S. Coast and Geodetic Survey; on magnetism from the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, and in marine biology from the Smithsonian Institution.

The National Broadcasting Company will send radio engineers to investigate radio phenomena, and will arrange a number of broadcasts by members of the scientific party from remote islands.

The cutter which will transport the expedition will be one of the newest and largest steel ships of the Coast Guard with a length of 327 feet and a displacement of 2,000 tons. It is fitted with the latest type of sonic depth-finders with which ocean depths are quickly ascertained by measuring the split-second time during which a sound travels to the ocean bottom and is echoed back. It carries a two-seater scout observation seaplane which will be used in making aerial photographs and maps of islands.

An important aspect of the work will be the attempt to solve by geophysical methods some of the fundamental geological problems of the Pacific. Stations on the various islands for gravity and magnetic determinations will be set up. At the same time the geology and structure of the islands will be studied. Although a number of magnetic determinations were made in the area a decade and more ago, no gravity work has been carried on there, and there has been no opportunity to relate magnetic, gravity and geologic observations.

The expedition will sail from San Francisco and will make one of its early stops at Canton Island, potential way-station for an air service between the

United States and Canada, on the one hand, and New Zealand and Australia on the other. Canton Island was the base of operations for another National Geographic Society expedition which, with the U. S. Navy, observed the total eclipse of the sun in June, 1937. It is now under joint American and British control. During its twelve months in the field, the ship will put in at intervals at Honolulu and Auckland, New Zealand, for supplies and mail.

The expedition, which will start next September and will be in the field for a year, will be conducted by the society and the University of Virginia, with the cooperation of the United States Coast Guard.

THE NEW YORK INSTITUTE FOR HOSPITAL ADMINISTRATORS

THE first New York Institute for Hospital Administrators opened a course of instruction on June 19 at the College of Physicians and Surgeons of Columbia University with an address by Dr. Malcolm MacEachern, associate director of the American College of Surgeons and president of the International Hospital Association. The institute will continue through July 1.

Authorities on all phases of hospital administration speak on the problems and progress in that field. Ninety hospital superintendents, assistant superintendents and department heads have enrolled for the course, which includes round-table discussions. No public meetings are scheduled.

The institute is sponsored by the American College of Hospital Administrators and the Greater New York Hospital Association in cooperation with the faculty of medicine of Columbia University. Dr. Claude W. Munger, director of St. Luke's Hospital, is director. Dr. S. S. Goldwater, commissioner of the Department of Hospitals, is chairman of the advisory committee.

Among the speakers are Dr. Haven Emerson, of the College of Physicians and Surgeons; Dr. Joe R. Clemmons, director of Roosevelt Hospital; Dr. C. Rufus Rorem, of the American Hospital Association; Dr. Frederick MacCurdy, superintendent of Vanderbilt Clinic; Miss Edith Field, record librarian of Grasslands Hospital, Valhalla, N. Y.; Emanuel Hayt; Dr. E. M. Bluestone, director of Montefiore Hospital; Miss S. Margaret Gillam, director of the department of nutrition, New York Hospital, and James A. Hamilton, director of New Haven Hospital.

The program is intended for those familiar with the hospital field and does not offer a training course in hospital administration. It is expected to stimulate ideas and improvement in the management of hospitals.

Two lectures are given each morning from 9 to 10:30 o'clock and from 10:30 to 12. In the afternoon, field trips to selected hospitals demonstrating various features of hospital administration have been arranged.

The subjects of the round table discussions of the evening sessions include hospital-care insurance, hospital financing, personnel management, nursing service, medical records, diet therapy, community relationships and the hospital as an educational institution.

A similar program for hospital administrators on the Eastern seaboard is being held this summer at Duke University, North Carolina.

MEETINGS OF THE THIRD COMMISSION OF THE INTERNATIONAL SOCIETY OF SOIL SCIENCE

THE third Commission of the International Society of Soil Science, concerned with the subject of soil microbiology, will hold meetings in New Brunswick, N. J., from August 30 to September 1, at the New Jersey Agricultural Experiment Station and Rutgers University. Papers will be presented on three subjects. The program on August 30 will be concerned with the subject of "Legumes and Legume Bacteria," and reports will be given by the following: W. A. Albrecht, University of Missouri; F. E. Allison, United States Department of Agriculture; A. Demolon, Centre National de Recherches Agronomique, Versailles; J. Dufrenoy, University of Bordeaux; H. Katznelson, N. J. Agricultural Experiment Station; L. T. Leonard, United States Department of Agriculture; K. V. Thimann, Harvard University; H. G. Thornton (president of the commission), Rothamsted Experimental Station, England; W. W. Umbreit and P. W. Wilson, University of Wisconsin; A. I. Virtanen, Biochemical Institute, Finland; A. L. Whiting, the Urbana Laboratories, Illinois. The subject of "Microbiology of Soil Organic Matter" will be discussed by the following on the morning of August 31: Chr. Barthel and N. Bengtsson, Lantbrukshögskolan, Sweden; F. E. Clark and Charles Thom, United States Department of Agriculture; D. Fehér, Institute of Forestry, Hungary; H. Murata, Kagoshima Imperial College of Agriculture and Forestry, Japan; A. G. Norman, the Iowa State College; C. E. Skinner, University of Minnesota; S. C. Vandecaveye, the Washington State College; S. A. Waksman, N. J. Agricultural Experiment Station; J. Marszewska-Ziemiecka, the National Institute for Agricultural Research, Poland. Papers will be presented on the subject of "Azotobacter and Its Significance in Soil Processes" during the afternoon of August 31 by the following: G. Guittonneau, Institute National Agronomique, France; C. K. Horner and Dean Burk, United States Department of Agriculture; H. W. Reuszer, Colorado Agricultural Experiment Station; R. L. Starkey, N. J. Agricultural Experiment Station; M. Winnik and M. Goldberg, Mikveh-Israel Experimental Station, Palestine. A conference will be held on "Legume Inoculants" under the direction of A. W. Hofer, of the N. Y. (Geneva) Agricultural Experiment Station. Following the meetings, there will be an excursion on September 1 to some of the agricultural regions of New Jersey.

The meetings are being held in close cooperation with the third International Congress for Microbiology, which will be opened on September 2. Those wishing information concerning the program and arrangements should communicate with R. L. Starkey, Agricultural Experiment Station, New Brunswick, N. J.

THE SIXTH PACIFIC SCIENCE CONGRESS

THE sixth Pacific Science Congress will be held from July 24 to August 12 at Berkeley, Stanford University and San Francisco, California, under the auspices of the National Research Council. The general arrangements are in charge of the Committee on Pacific Investigations of the council. Responsibility for perfecting the program and for local arrangements has been assigned to a committee on the sixth Pacific Science Congress. In the detailed conduct of the congress, the committees in charge will be represented by an executive committee. Cooperating with these committees is the Department of the Pacific Area of the Golden Gate Exposition, 1939, of which Dr. Ray Lyman Wilbur, president of Stanford University, is chairman, and Philip N. Youtz, director.

Stanford University and the University of California will be the host institutions for the congress. The Golden Gate International Exposition will assist and cooperate with them. The sessions of the first period, from July 24 to August 5, will be held mainly at the University of California at Berkeley, which will provide meeting places. The sessions of the second period, from August 6 to 12, will be held at Stanford University.

Through the courtesy of the State Department of the United States, invitations to participate have been extended to forty-two countries which are either included in the Pacific area or have dominions, colonies, territories or dependencies within the area. Individual invitations have also been extended to many scientific men in these countries to contribute to the section programs. The following reports of standing committees authorized by the fifth Pacific Science Congress will be presented:

Oceanography of the Pacific, Thomas G. Thompson, *chairman*, professor of chemistry and director of Oceanographic Laboratories, University of Washington.

Volcanic Rocks, Patrick Marshall, *chairman*, vice-president, Royal Society of New Zealand; testing officer, Public Works Department, Wellington.

Blood Groups, L. T. Ride, *chairman*, professor of physiology, University of Hong Kong.

Protection of Nature, M. Miyoshi, *chairman*, professor of botany, emeritus, Imperial University of Tokyo, and Carl Skottsberg, *secretary*, professor of botany, University of Göteborg, and director of the botanical gardens.

Soil Survey and Classification, Boris B. Polynov, *chairman*, commission for the nomenclature, classification and mapping of soils, International Soil Science Association, Groningen, Netherlands.

Classification and Utilization of Land, W. C. Lowdermilk, *chairman*, chief, Research Division, U. S. Soil Conservation Service.

Forest Resources, D. Y. Lin, *chairman*, director of forestry, Ministry of Economic Affairs, Chunking, China.

Pacific Economic Entomology, Harry S. Smith, *chairman*, professor of entomology in the Citrus Experiment Station and Graduate School of Tropical Agriculture of the University of California, Riverside.

Mountain Structures, H. A. Brouwer, *chairman*, professor of geology and director of the Geological Institute, University of Amsterdam.

Seismology, Ernest A. Hodgson, *chairman*, seismologist, Dominion Observatory, Canada.

The special program is divided into eight sections as follows:

The Pacific Basin; structure and dynamics: geology and geophysics.

The Pacific Ocean; properties, dynamics, life: oceanography and marine biology.

Pacific climates, past and present.

Man and culture in the Pacific region; characteristics, dispersal and development, objectives and results of research: anthropology, human geography and ethno-botany.

Terrestrial fauna of the Pacific islands and bordering lands; characteristics, origin, distribution, human relations: animal sciences.

Terrestrial flora of the Pacific islands and bordering lands; characteristics, origin, distribution and human relations; plant sciences.

Public health and nutritional problems of the Pacific region; tropical medicine and nutrition.

Soil problems of the Pacific islands and bordering lands; characteristics, utilization, conservation.

The public sessions that have been arranged include one to be addressed by Dr. Beno Gutenberg, professor of geophysics and meteorology, California Institute of Technology; another by Dr. Elmer Drew Merrill, professor of botany at Harvard University, and a third by Dr. H. U. Sverdrup, director of the University of California Scripps Institution of Oceanography at La Jolla. A number of excursions are planned to points of scientific interest.

SCIENTIFIC NOTES AND NEWS

The seventy-fifth birthday of Dr. Frank M. Chapman, curator of birds and member of the scientific staff of the American Museum of Natural History for more than fifty years, was observed on June 12 at a luncheon in the Flying Bird Hall which was attended by members of the scientific and administrative staffs and by friends of Dr. Chapman. After the luncheon Dr. John T. Zimmer, executive curator of birds, presented him with a volume of a hundred and fifty birthday letters from friends throughout the world, and F. Trubee Davison, president of the museum, unveiled a bronze bust of Dr. Chapman, the work of Mrs. Bessie Potter Vonnoh. It will be installed permanently in one of the bird halls.

Friends and associates of W. W. Skinner tendered him a dinner on May 16 to celebrate his appointment as associate chief of the Bureau of Chemistry and Soils, which after July 1 will be known as the Bureau of Agricultural Chemistry and Engineering. Dr. Skinner has been identified with the bureau for thirty-five years. H. G. Knight, chief of the bureau, acted as toastmaster.

The doctorate of laws was conferred by St. Lawrence University, Canton, N. Y., on June 12 on Dr. Karl T. Compton, president of the Massachusetts Institute of Technology, who gave the principal address.

Dr. S. C. Lind, dean of the Institute of Technology of the University of Minnesota, was awarded the honorary degree of doctor of science by Washington and Lee University at its one hundred and ninetieth commencement on June 9.

Lehigh University conferred at its commencement exercises the degree of doctor of science upon Dr. Dexter S. Kimball, dean emeritus of the College of Engineering of Cornell University.

Dr. Merritt F. Miller, dean of the College of Agriculture of the University of Missouri, has received the degree of doctor of science from the Ohio State University.

The honorary degree of doctor of science was conferred on June 13 by Waynesburg College, Pennsylvania, on Dr. Edward R. Weidlein, director of the Mellon Institute, who delivered the commencement address.

At Christ's College, Cambridge, Dr. Charles Galton Darwin, who recently retired from the mastership of the college to take up the appointment of director of the National Physical Laboratory, has been elected into an honorary fellowship of the college.

Dr. Sigismund S. Goldwater, commissioner of hospitals of New York City, recently received the third annual award of the City Club. This award is made annually to "a non-elective public servant who has in the estimation of the trustees rendered outstanding public service to the city."

Professor Herissey, who holds the chair of biological chemistry at the Faculty of Medicine of Paris, and Professor Léon Binet, who holds the chair of physiology, have been elected to membership in the Paris Academy of Medicine. Professor Marc Tiffeneau, dean of the Faculty of Medicine, has been elected a member of the Academy of Sciences.

Dr. E. D. Adrian, professor of physiology, will represent the University of Cambridge at the bicentenary ceremonies of the Royal Swedish Academy of Sciences, Stockholm, which will be held on September 23, 24 and 25.

At the recent anniversary meeting of the Linnean Society of London the following officers were elected for the year 1939–40: *President,* Dr. John Ramsbottom; *Treasurer,* Francis Druce; *Secretaries,* Isaac H. Burkill (botany) and Dr. Malcolm A. Smith (zoology); *New Members of Council,* Professor T. M. Harris, H. R. Hewer, Professor T. G. B. Osborn, H. W. Parker and Dr. Malcolm A. Smith.

At the annual general meeting of the British Institute of Physics the following officers were elected: *President,* Professor W. L. Bragg; *Vice-president,* Professor A. Ferguson; *Honorary Treasurer,* Major C. E. S. Phillips; *Honorary Secretary,* Professor J. A. Crowther; *New Members of the Board,* Dr. H. Lowery and R. S. Whipple, and J. H. Awbery, appointed by the Physical Society.

Dr. John Y. Graham, since 1897 professor of biology at the University of Alabama, will retire from active service at the close of the college year.

Dr. Karl Dale Swartzel, since 1922 professor and head of the department of mathematics at the University of Pittsburgh, retired on June 14.

Dr. James G. Horsfall, professor of plant pathology and chief of research at the New York State Agricultural Experiment Station at Geneva, N. Y., has been appointed head of the department of botany of the Agricultural Experiment Station at New Haven. He succeeds the late Dr. G. P. Clinton, who died in 1937 after completing thirty-five years in the service of the state.

Dr. Walter A. Bloedorn, professor of medicine at the George Washington University School of Medicine, has been appointed dean of the school to fill the vacancy that occurred when Dr. Earl B. McKinley was lost on the Hawaii Clipper in July, 1938.

Dr. George P. Murdock, chairman of the department of anthropology of Yale University, has been promoted to a professorship of ethnology.

Dr. Tracy M. Sonneborn, of the Johns Hopkins University, has been appointed associate professor of zoology at Indiana University.

Dr. J. T. Irving, head of the department of physiology of the Rowett Research Institute, Aberdeen, has been appointed to the chair of physiology in the University of Cape Town.

Dr. James P. Schooley, research associate in endocrinology at the department of genetics, Carnegie Institution of Washington, Cold Spring Harbor, Long Island, N. Y., has resigned to become director of endocrine research at Difco Laboratories, Incorporated, Detroit.

Dr. Herman N. Bundesen, who has been on a leave of absence since November, 1938, has returned to his work as health commissioner and president of the Board of Health of Chicago. Dr. Robert A. Black has been acting president of the board during his absence.

Dr. H. P. Smith, professor of pathology at the College of Medicine of the State University of Iowa, has received a grant of $1,500 from the John and Mary R. Markle Foundation for further studies in blood coagulation and hemorrhagic diseases. This grant is in addition to one of $10,000 previously awarded for studies in this field.

A reorganization of the editorial board of *The American Journal of Anatomy*, necessitated by the recent death of Dr. Charles R. Stockard, who was managing editor for seventeen years, has been completed. The appointment of Dr. George W. Corner, the University of Rochester, to be managing editor in succession to Dr. Stockard, has already been announced. Dr. George L. Streeter, the Carnegie Institution, Baltimore, who has been an associate editor for many years, will continue in that capacity. Dr. C. M. Jackson, the University of Minnesota, has asked to be released from editorial duties after eighteen years' service. The following have been appointed associate editors: Dr. Wayne J. Atwell, University of Buffalo; Dr. Sam L. Clark, Vanderbilt University; Dr. Harold Cummins, Tulane University, and Dr. George B. Wislocki, Harvard University.

At a symposium of invited papers on "Nuclear Fission," to be held by the American Physical Society at a regular meeting of the society on June 23 and 24, Dr. M. A. Tuve, of the Carnegie Institution of Washington, speaks on "The Discussion of Experimental Information Regarding Fission Processes," and Professor John A. Wheeler, of Princeton University, speaks on "The Mechanism of the Nuclear Fission."

Professor W. L. Ayres, of the University of Michigan, gave two addresses on May 31 before the department of mathematics of Wayne University on "The Coloring of Maps" and on "Peano Spaces and Their Decomposition."

Dr. James Rowland Angell, educational counselor of the National Broadcasting Company, president emeritus of Yale University, was the commencement speaker on June 15 at the University of Buffalo.

An exchange of visits has been arranged between the Kaiser Wilhelm Gesellschaft of Berlin and the Royal Society of London. As part of this arrangement Professor Baron von Verschuer, of Frankfurt, a.M., delivered on June 8 a lecture at the Royal Society entitled "Twin Research from Francis Galton to the Present Day," and on June 9 Professor Richard Kuhn, of Heidelberg, delivered a lecture on "Chemical Bases of the Biological Action of Light."

Plans are being made for the perpetuation in an American Museum of Health of most of the exhibits in the Public Health and Medicine Building at the World's Fair. Dedication ceremonies of the new organization, which is supported by funds from philanthropic groups and insurance companies, were held in the Public Health and Medicine exhibit on June 17. The speakers included Mayor La Guardia, Surgeon General Thomas Parran, Dr. John L. Rice, city health commissioner, and Grover A. Whalen, president of the fair. Dr. Livingston Farrand, president emeritus of Cornell University, acted as chairman. A building to house the exhibits of the new museum has not yet been selected. Cooperation in obtaining a site for the museum has been promised by Mayor La Guardia, one of the directors. Other directors include Dr. Louis I. Dublin, Dr. George Baehr, Homer N. Calver, Dr. Farrand, Dr. David J. Kaliski, Sam A. Lewisohn, James Marshall, George McAneny, Dr. Seth Milliken, Frederick Osborn and Dr. Rice. Contributing to the support of the museum are the Carnegie Corporation of New York, the Rockefeller Foundation, the Oberlaender Trust and eight insurance companies.

The new building of the Memorial Hospital for the Treatment of Cancer and Allied Diseases, New York City, was dedicated on May 15. Among the speakers at the ceremony were Dr. James Ewing, director of the hospital; Dr. J. G. Schurman, formerly president of Cornell University, later ambassador to Germany; Dr. S. S. Goldwater, commissioner of hospitals, New York City; Dr. William D. Coolidge, director of the Research Laboratories of the General Electric Company at Schenectady; Dr. Ludvig Hektoen, director of the National Cancer Council, and Dr. Burton T. Simpson, director of the New York State Institute for the Study of Malignant Diseases. Dr. James B.

Murphy, of the Rockefeller Institute, presided at the morning session, and Walter Douglas, chairman of the board of managers of the hospital, presided at the dedication ceremony. Mr. Robbins declared the institution officially opened and invited the guests to inspect the building. The cost of the new plant was approximately $5,500,000. John D. Rockefeller, Jr., gave the site. The principal donations for the construction were $3,000,000 from the General Education Board and $500,000 from Edward S. Harkness.

THE new Whitney Memorial Wing at the American Museum of Natural History, built at a cost of $1,500,000 after ten years of planning and preparation, was dedicated on June 6 before a gathering of five hundred invited guests, including J. P. Morgan and Mrs. Harry Payne Whitney. The new building, which has eight stories and which will house a collection of 750,000 birds, is the joint gift of the late Harry Payne Whitney and of New York City. It contains three floors of public exhibits, including the Whitney Memorial Hall, the Hall of the Biology of Birds and the Gallery of Bird Art. Four floors house the large collection of specimens and on the top floor are the new laboratories designed for the study of living birds.

Museum News states that the North Central Washington Museum Association has been organized and incorporated at Wenatchee, Wash., and has obtained the use of the former city library for a museum. This building is being renovated through donated services and material. Enough exhibits are expected to be in place so that the museum can be opened this month. It will include art, history and science in its program. The organization of the association and the acquisition of the building are in large degree the result of efforts, beginning many years ago, on the part of the Columbia River Archeological Society, of which Alan G. May is president. Officers of the Museum Association are K. P. Sexton, *president;* Mr. May, *vice-president;* A. V. Shephard, *secretary,* and Mrs. Gilbert Brown, *treasurer.*

THE Congress has been asked for a special appropriation for the Department of Commerce to finance a study of the fishery resources of the Hawaiian Islands as part of a plan for the development of the fisheries of the islands. The study would include a survey of available aquatic resources from which fisheries which now show signs of depletion could be restored. A preliminary report by the Bureau of Fisheries recommends that a survey be conducted to determine the species of fish which are available in the seas surrounding the islands.

THE New York Academy of Medicine announces the establishment of "The Robert Livingston Seaman Fund for the furtherance of research in bacteriology and sanitary science," with six hundred dollars available for assignment in 1939. This fund has been made possible by the terms of the will of the late Dr. Robert Livingston Seaman and will be administered by a committee of the Academy of Medicine under the following conditions and regulations: (1) The committee will receive applications from either institutions or individuals during the summer and up to September 15, 1939. Communications should be addressed to Dr. Wilson G. Smillie, chairman, 2 East 103rd Street, New York City. (2) The fund will be expended only in grants in aid for investigation or scholarships for research in bacteriology or sanitary science. The expenditures may be made for the securing of technical help; for aid in publishing original work and for the purchase of necessary books or apparatus.

DISCUSSION

THE DISCOVERY OF ANTARCTICA: A REPLY TO PROFESSOR R. N. RUDMOSE BROWN

IN the *Scottish Geographical Magazine* of May, 1939,[1] Dr. R. N. Rudmose Brown, the eminent British geographer, has reviewed my recent monograph[2] in an effort to impeach its accuracy and establish the British claim that Bransfield discovered the Antarctic continent.

In his article Brown has used terms so loosely and has misquoted me so generously that a full reply to all his statements would not be practicable within the compass of this article. I shall, therefore, content myself by whatever of reputation I may have for thoroughness of research and for a practice of resorting wherever possible to original source material. I shall hope that the more serious student of Antarctic history may be led to read my monograph as well as the British reviews of it.

In my investigation of this subject I started out determined to leave no stone unturned in order to get access to all available facts, let them strike where they would.[3] The picture uncovered by my studies was not an attractive one and, as it happened, not one in which the British Admiralty or British geographers generally could take pride. It has been expected that such explosions as have come from Messrs. Brown and Hinks[4] would not be long delayed.

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[1] *Scottish Geographical Magazine*, 55: 3, 170–173; see also *Nature* of April 29, 1939.

[2] *Trans. Amer. Philos. Soc.*, n. s., 31: pt I, January, 1939, pp. 1–71, pls. I–XXXI, text maps 10.

[3] Dr. Brown seems to have overlooked the fact that I have classed the American sealer, Benjamin Morrell, as a fake explorer. He did not, like Weddell, purloin a map or falsify one, but he did claim to have sailed into the Weddell Sea about half as far as Weddell's alleged cruise, and he has been generally discredited by British writers.

With this preliminary statement let me refer to some of the more fundamental strictures of Professor Brown which seem to require an answer. He states that "two accounts have been published" of the cruise of the brig *Williams* into Antarctic waters when Bransfield was her master. The first is the authentic account by Dr. Adam Young, R.N., surgeon of H.M.S. *Slaney*, one of the five Royal Navy officers on board the vessel. Dr. Young supplied the published account of the expedition, which appeared in April, 1821, in a Scottish scientific journal of high repute, the Edinburgh *Philosophical Journal*. This report, which was issued within a year of the time the news could have reached Europe, was accepted by geographers in both Europe and America. The Smith-Bransfield map reprinted from the Edinburgh journal was entered in atlases all over the world. Fourteen of these atlas reproductions of the Bransfield map I found in various libraries, and thirteen of them I reproduced. There may be others.

The "other account" referred to by Brown is an *anonymous* one which appeared a year and a half later in an obscure journal a few weeks only after the publication in London by the Admiralty's chart maker and seller of a map of Palmer's Land named for its discoverer, the American sealing captain, N. B. Palmer. Palmer had discovered the land on November 18, 1820, as described in his log, now in the Library of Congress. The belated story in the *London Literary Gazette*, quite unlike the official account by Surgeon Young, described an additional cruise of Bransfield's vessel some 250 miles farther to the east than in the authentic account, with the discovery of the Elephant-Clarence Island group; then a return cruise which was continued along the south side of the South Shetland "land mass"; then a diversion to the south with the discovery of the Antarctic continent in about the same position as Palmer Land. The land was named in this account "Trinity Land," not the Holy Trinity, but for a triune division within the British Admiralty.

This later account, covered by a convenient anonymity, but which awards the discovery of the Antarctic continent to a British naval officer, is preferred by Brown, though he thinks "the nationality of the discoverer of Antarctica is of no consequence." Yet Brown would probably agree that efforts should be made to do justice to the individual explorers themselves, be they British or American.[5]

Dr. Brown has stated loosely that a map by Bransfield to show this cruise was "published" by the Admiralty. He is in error. There is an unpublished map engraved at the Hydrographical Office made to fit the anonymous account, and also a similar drawn chart without track of the vessel but with the signature "Bransfield." The engraved sheet is dated November 30, 1822, which is a month after the Palmer's Land map had been printed by R. H. Laurie, the chart publisher of the Admiralty.

There is also filed in the Hydrographical Office of the Admiralty an unpublished map ascribed to the British sealer William Smith, which sets forth his discoveries when he on February 19, 1819, first sighted the South Shetland Islands. Though as shown by both his authentic published log and chart (and by this chart as well) Smith had kept well to the north of the group, which he had taken for an Antarctic "land mass." Yet according to this map he had surveyed an *island* group, *on all sides* and in rough agreement with good later maps. He had even sighted the Antarctic continent a full degree of latitude farther away to the south behind the islands. This land was represented to be in the approximate position of the "Trinity Land" of the "Bransfield" unpublished chart. This alleged Smith map, obviously a forgery, and the "Bransfield" unpublished map were both a full century and more later published in the journal of the Royal Geographical Society and exploited to prove that Smith in February of 1819 and Bransfield in January of 1820 had each sighted the Antarctic continent.

Laurie, who as the Admiralty's chart publisher of course knew of these unpublished charts, wrote in the Notes accompanying the Palmer-Powell map of 1822: "The *Trinity Land* and *Tower Island* of the first charts, in about 63½° South and 60½° West are given up as imaginary, or as icebergs only."[6] The amazing thing is, not that the Admiralty decided not to publish such maps, but that British geographers (Bruce, Brown, Markham, Mill and others) have exploited the "Trinity Land" map to replace the authentic Smith-Bransfield map.

Though the Admiralty did not publish the chart as claimed and did not assign it a number, it did a little later (1824) *officially publish* a chart on which Palmer's Land is reproduced with photographic accuracy from the Palmer-Powell map, three different editions of which Laurie had himself already published in 1822. The pertinent portion of this Admiralty map is here reproduced in Fig. 1.[7]

The publication of this official Admiralty map is of much importance. At the bottom of it is printed,

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[4] See end of my article, "The Pack-ice of the Weddell Sea," *Annals Assoc. Amer. Geog.*, 29: 2, June, 1939, pp. 159–170.

[5] As long ago as 1927 Dr. Brown was arguing for Bransfield against Palmer for the discovery of Antarctica upon the basis of the map in the Hydrographical Office ("The Polar Regions," 1927, p. 23).

[6] Notes on South Shetland, etc., 1822, p. 6.

[7] The first *published* map of "Trinity Land" is that by James Weddell, which appeared in 1825.

"London, published according to Act of Parliament at the Hydrographical Office of the Admiralty Nov^{r} 4th, 1824. Sold by R. B. Bate, 21 Poultry, for the Lords Commys^{D}. of the Admiralty, by their Appointment." Following the publication of this Admiralty chart, five British atlas publishers printed Palmer's Land upon their maps. It was later that the Admiralty exploited "Trinity Land," and still later "Graham Land" to replace Palmer's Land.

That, unlike the unpublished but alleged map of Bransfield which I have characterized as a fake, this Admiralty map was actually issued is further proven by the fact that a copy is found in the United States. The one here reproduced in part is from the Library of Congress and bears the title, "General Chart of South America. From the Drawing by Lieut. A. B. Becher, R.N. combined with the best English and Spanish Surveys in the Hydrographical Office and adjusted by the latest Astronomical Observations."

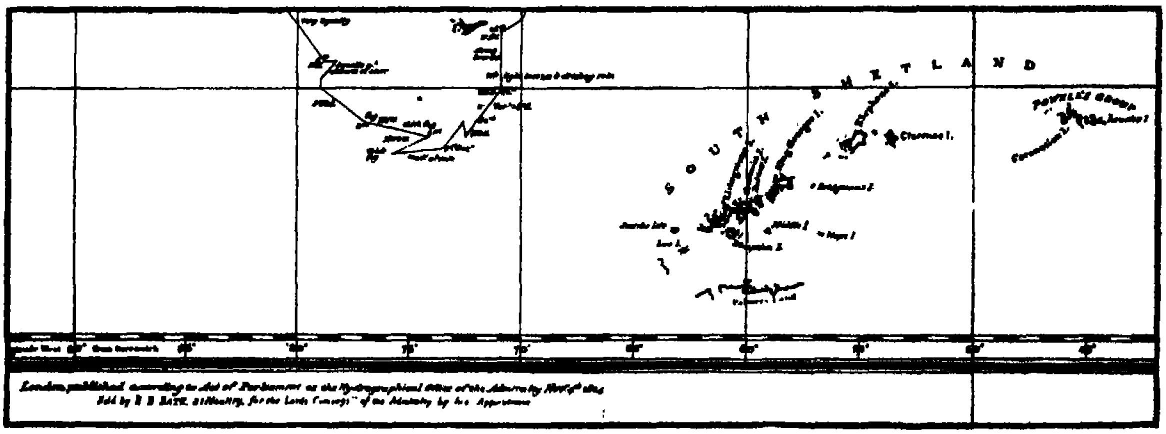

Fig. 1. Portion of the first official map of Antarctic land published by the British Admiralty (reduced one third).

If the alleged Bransfield map at the Admiralty had been regarded as genuine—it is dated 1820—it is certainly remarkable that the Admiralty should issue this its first official map with Antarctic land in 1824, which is a year before their Royal Navy Captain, James Weddell, printed his map of "Trinity Land" "laid down from the information of respectable commanders of ships"—a map as different from the alleged Bransfield map as it is from the map of Palmer's Land.

Brown is again in error when he refers to my "exoneration of Palmer for making no mention of his discovery of land in his *official* log." I have done no such thing. Palmer does mention the land both in his log and in his diary. Brown appears to have read my monograph very carelessly and has here confused my statement that Palmer did not mention *in his log* the meeting with Bellingshausen, though he does treat it at length in his journal or diary.

Another example of careless reading is Brown's reference to the Palmer cruise of January, 1822 (he makes it 1821), which he has confused with the first discovery by Palmer of Antarctic land in 1820.

To discredit the Woodbridge map of September 28, 1821, on which Palmer's Land and the Shetland Islands appear quite correctly placed, and which is the first known published map that shows Antarctic land on the basis of discovery, Brown says, "A school atlas can scarcely be accepted as documentary proof of Palmer's precedence in discovery." The Woodbridge map, which is reproduced as the frontispiece of my monograph and is thus dated, is not a school map at all. William Channing Woodbridge was one of the most reliable American map-makers of his time, and his atlases became standard works. The atlas here in question has the title, "Modern Atlas on a New Plan to Accompany the System of Universal Geography, by William C. Woodbridge." It is true Woodbridge published *in addition* a school map upon a smaller scale on which the same material appears. Once more Dr. Brown has read very carelessly.

Brown's criticisms concerning Weddell and his alleged cruises, he has also treated in the issue of ***Nature*** for April 29, 1939, and I have met these criticisms in advance by my article published in the June number of the ***Annals of the Association of American Geographers***. It seems therefore unnecessary to repeat them here.

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University of Michigan
June 1, 1939.

HYPHENATION OF ENGLISH COMPOUND NAMES

In a recent issue, Weatherby[1] calls attention to the growing use of compound nouns in the English language, with the comment that we may be in a transitional period, the final outcome of which will be the compounding of such words without separation of the parts by either space or hyphen, as in the Germanic languages. Perhaps it may be because of the present transitional state of the language that there seem to be no very definite rules as to when hyphens should be employed in such English compound nouns. Originally, perhaps hyphens were the general rule; but gradually usage has justified the omission of the hyphen in many cases. Then when two compound terms are compounded together, with the use of a single hyphen, the results are sometimes curious; *e.g.*, "the Great Northern-Northern Pacific railway system," a term which is clear enough to an American, but might puzzle a foreigner.

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[1] C. A. Weatherby, Science, 89: 414, 1939.

As editor of *Stain Technology*, the writer has to struggle again and again with the problem of hyphenation of compound names, trying to solve it in a way that is logical, consistent and at least fairly grammatical. Thus, although the term "spore former," as two words without a hyphen, is undoubtedly sanctioned by usage, the logic of "non-spore former" seems at least questionable; just what is a "non-spore"? This latter compound noun is quite simply improved by introducing a second hyphen; but when an author tries to describe some technic by the use of a compound term made up of all the principal ingredients used (themselves often compound nouns), the problem becomes more complicated. It is hard to justify such terms as "safranin-orange G-crystal violet technic" or "iron alum-hematoxylin phenol-Bismarck brown Y schedule." Such expressions as these are perhaps unambiguous to any one familiar with the names of dyes and the nature of staining solutions; but the layman, looking at the former, would never suspect that the "G" belongs with "orange" and "crystal" with "violet."

Does English have any rules for the hyphenation of such a compound term? The writer has been unable to find any, presumably because such compounding was originally foreign to the language. Granted that Weatherby is right in assuming that compound terms will some day be frankly recognized and written as one word, let us hope that some one will devise a system for use in doubly and triply compounded words to show which elements belong most closely together and which are related to the others more indirectly.

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USE OF PARENTHESES IN ZOOLOGICAL NOMENCLATURE

IN a recent communication, Dr. Osgood[1] ably argues for dropping the parentheses about authors' names when the specific designation of an animal has been changed. One of his arguments is that parentheses are unnecessary to the specialist and both unnecessary and confusing to the layman (such as, I suppose, a visitor to a museum).

Personally, I hold no thesis in this matter and am perfectly willing to follow any convention which seems to the majority wisest; but I wish to point out that not all who use zoological names are specialists in taxonomy nor, strictly speaking, laymen. General zoologists are often temporarily befuddled by the rapidity of changes in nomenclature, however wise and necessary these changes may be in themselves.

Recently, I have had occasion to make use of an extensive taxonomic literature upon a group whose members are not well known to me. In this task, I have found the conventional use of parentheses very helpful in tracing synonymy and I suspect that other non-taxonomic zoologists may have had similar experiences.

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[1] SCIENCE, 89: 9–11.

QUOTATIONS

DISTRIBUTION OF THE YOUNGER STARRED SCIENTISTS[1]

THE distribution of productive scientists is certainly of great significance in an age of science, and can advantageously be studied geographically. A summary of the findings is of special interest to the scientists themselves.

Cattell has published, in the appendices of "American Men of Science," 1906–1933, some data as to the places of birth, education and work of the scientists who were, between 1903 and 1932, starred, by vote of their fellow specialists, as especially distinguished in research.

In the following discussion the scientists first starred in the sixth edition of "American Men of Science," issued in August, 1938, receive especial attention; but the 1938 distribution of all the living scientists starred in 1921–1937 is discussed. Detailed attention is given to the starred astronomers, geologists, chemists, physicists and mathematicians. Some comparisons are made, also, with the older groups of scientists, those starred in 1903 or 1910, nearly all of whom are now dead or retired.

DISTRIBUTION BY OCCUPATION, AGE, SEX

The occupational distribution of those of the nearly 500 scientists starred in 1932 or 1937 who report their employment in the 1938 edition of "American Men of

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[1] Extracts from an article in the issue of the *American Journal of Science* for January, 1939.

Science" is of interest. Seventy-six per cent. are connected with educational institutions and presumably are supported by their teaching. Only one twelfth are connected with research institutions and only one fifteenth are in government employ (aside from the state universities). Half of those employed by the Federal Government are in the Geological Survey. Less than one sixteenth are in applied or commercial science. Research institutions employ relatively many astronomers, chemists, pathologists and physicists. Comparison with the situation in 1906 and 1921–27, reported by Cattell, indicates that there has been a sharp decline in the number of anthropologists in federal employment; a sharp gain in the number of astronomers and botanists employed by research institutions; of geologists, the number in the U. S. Geological Survey has remained about stationary, the number in universities and state surveys has declined; in pathology there has been a shift to research institutions. Of the zoologists, there are far fewer in federal employment, more in research institutions and about the same proportion as formerly in universities.

The year of birth is available for all but four of the group starred in 1937. Two were born before 1870, 11 in the 1870's, 61 in the 1880's, 108 in the 1890's and 64 since then, the youngest in 1911, the next youngest in 1908, and 9 since 1905. The median year of birth is 1895. Age at starring: eight in the 60's, 21 at ages 55 to 59, 27 in the early 50's, 100 in the 40's, 56 in the last half of the thirties, 21 in the early 30's, 2 at 28, one at 26. The average age at starring is almost 43 years. (For the 1932 group, Cattell found the average age at starring of mathematicians and physicists to be 36, chemists 41, psychologists 44, biologists 46, pathologists 48, geologists 49.) Although the average age at starring of the 1937 group is almost exactly the same as for the 1932 group, the distribution is somewhat less concentrated, a third more being over 55 or under 36 at starring; one quarter instead of one third being aged 40 to 46. The youngest man of the 1932 starring was 27, another was 28, four others were 29 and seven were 30. Four were in their 60's in contrast with eight of the 1937 group.

Nine women were starred in 1937, four of whom were married; three are zoologists, two geologists; one each, in anatomy, astronomy, botany and psychology. In 1932 three women were starred; two zoologists and one anthropologist.

Distribution by Institutions

Table I gives by leading institutions the 1938 distribution of the scientists first starred in 1921–1937, according to the sixth edition of "American Men of Science." This table shows that the leading universities in this respect are Harvard 69, Chicago 45½ (a part-time person is given a half-rating), Columbia 39½, California 39, Yale 35, Michigan 32, Princeton 31, Hopkins 30 and Minnesota 26. The leading institutions which are not universities are the Carnegie Institution of Washington (31½), the U. S. Geological Survey (23½) and the Rockefeller Institute and Foundation (24).

TABLE I

Starred Scientists at Leading Institutions in 1938
Number of Those Starred in the Year Indicated

	1921	1927	1932	1937	Total
Bell Tel. Lab.	2	6	2	3	13
Brown	6	1	1	0	8
California	8	7	14	10	39
Calif. Inst. Tech.	4	4	3	12½	23½
Carnegie Inst.	8	10	6	7½	31½
Chicago	9	14	11	11½	45½
Cincinnati	3	0	1	2	6
Columbia	13	9	10	7½	39½
Cornell	9	4½	7	5	25½
Duke	1	2	0	2	5
Harvard	17½	17½	17	17	69
Hopkins	10	4	7	9	30
Illinois	5	4	8	6	23
Iowa	1	0	4	3	8
Iowa State Col.	0	2	1	2	5
Kansas	2	2	1	0	5
Mass. Inst. Tech.	4	4	6	8	22
Michigan	8	4	11	9	32
Minnesota	8	4	9	5	26
N. Y. U.	1	2	1	3	7
North Carolina	1	2	1	2	6
Northwestern	5	1	2	4	12
Ohio	4	3	3	3	13
Pennsylvania	6	9	3	5	23
Princeton	6	4	10	11	31
Rockefeller	6	7	7	4	24
Rochester	2	1	4	3	10
Stanford	6	5	7	6	24
Swarthmore	2	1	0	2	5
Texas	2	3	1	½	6½
Thompson Inst.	1	1	1	2	5
United States					
Bureau of Standards	6	4	1	3	14
Dept. of Agriculture	2	3	2	5	12
Geol. Survey	4	7	5	7½	23½
National Museum	4	4	2	2	12
Virginia	1	1	3	1	6
Wash. (St. Louis)	3	2	3	1½	9½
Wisconsin	5	6	5	3	19
Yale	8	8	13	6	35

Schools with 4 each are: George Washington, Rutgers, St. Louis, Wesleyan. Schools with 3 each are: Indiana, Mt. Holyoke, Nebraska, Oberlin, Penn State, Pittsburgh, Tulane, Western Reserve. Schools with 2 each are: Arizona, College of the City of New York, Colorado Col., Conn. State, Rice, Trinity and Vanderbilt.

The totals given in Table I may be compared with corresponding data for 1906 given by Cattell. Universities which have about the same number of starred scientists on their faculty in 1938 as in 1906 are: Harvard with 66 in 1906 and 69 in 1938; Hopkins with 30, 30; Mass. Inst. Tech., 20, 22; Wisconsin 18, 19; Iowa 7, 8; Cincinnati 6, 6; North Carolina 5, 6; Kansas 5, 5; Western Reserve 4, 3; Texas, 5, 6½; Vassar 3, 3; Virginia, 7, 6.

Universities which have gained notably between 1906 and 1938 are: California 27 to 39; Yale 26 to 35; Michigan 20 to 32; Illinois 6 to 23; Princeton 15 to 31; Chicago 39 to 45½; Pennsylvania 17 to 23; Stanford 16 to 24; Washington (St. Louis) 5 to 9½; Ohio 10 to 13; Brown 5 to 8; and Northwestern 9 to 12; California Institute of Technology, not in existence in 1906, had only 7 starred men in 1927, but 23½ in 1938; Minnesota 10 to 26.

Universities which had fewer starred men on their faculty in 1938 than in 1906 include Columbia, 60 in

1906, 39½ in 1938; Cornell 33, 25½; Dartmouth 6, 1; New York 9, 7; Clark 7, 1; Indiana 6, 3; Missouri 9, 1; and Wesleyan 7, 4.

Since the 1938 edition of "American Men of Science" was put into type, more than a dozen men starred in 1921–1937 have died and several have moved. Hence the data given above are only approximately correct. A recently issued federal report[2] gives the distribution of starred scientists who were not yet 66 early in 1938. According to that table, which counts equally all persons in any way connected with the institution (not giving half weight as was done in the above article), Harvard, in 1938, had 83 starred scientists under age 66, Chicago 54, Columbia 50, California 47, Yale 41, Hopkins 36, Princeton 34, Minnesota 29, Michigan 28, Stanford 28, Cornell 26, Pennsylvania 25, California Institute of Technology 25, Wisconsin 22, Massachusetts Institute of Technology 22, Illinois 21. In federal service: the Geological Survey had 20, Bureau of Standards 16, Smithsonian Institution 11, Department of Agriculture 10; all other bureaus a total of 14.

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SPECIAL ARTICLES

PRE-LINGUISTIC SIGN BEHAVIOR IN CHIMPANZEE

THE expression "symbolic behavior" has been used frequently for types of adaptation which resist explanation by accepted principles of "animal learning," or even as substitute for "insight" and "higher mental processes." It is true that some of the most impressive contrasts between the behavioral capacities of man and other primates may be attributed to linguistic process or neural mechanism which is present in the former and either absent or rudimentary in the latter. Thus the great difficulty of double alternation[1] and temporal maze[2] problems for animals other than man may be attributed to inability to count. Likewise, differences in ability to respond to complex, obscure or novel relations, as in multiple-choice problems,[3] in rate of acquiring simple discrimination habits and in various tests of "reasoning" and "insight," are subject to a similar anthropomorphic explanation.

Analysis reveals, however, that many of these manifestations of behavioral adaptivity can be accounted for, without the postulation of symbolic processes, in terms of innate and acquired perceptual organization, generalization, transfer, processes involved in delayed conditioning and other relatively simple and widely applicable determinants of animal behavior. For example, performance in double alternation and temporal maze experiments might be explained as differential conditioning to two stimuli in a series of intraorganic stimulus-responses initiated by the external situation. Logically viewed, adaptive response to relations of varying degrees of complexity and unusualness, as widely exhibited in the animal kingdom, should not require the appearance of an entirely new process at some point in the series of events. Indeed, few if any of the attempts to account for tool using or construction and for other presumptively "insightful" problem solutions, occasionally exhibited by animals, have excluded the possibility that perceptual organization and transfer may suffice as principles of explanation.

Considerations, elsewhere discussed,[4] which suggest the operation of symbolic processes in delayed response will be summarized briefly. In infrahuman animals the establishment of a discrimination habit *in the absence of spatial cues* commonly requires a large number of differential rewards and frustrations, whereas the establishment of a comparable habit in delayed response tests *when spatial cues are available* may occur in a single trial and with signified versus actual reenforcement.[5] This contrast may be accounted for by the relative obtrusiveness and prepotency of the two varieties of cue or by the diversity of mechanism operative in the two cases. Man adapts as promptly to the delayed response type of situation without spatial cues as with them. It seems probable that his success is due entirely to capacity for linguistic response—use of symbols for white-black or right-left, as the case may be. The diverse observations cited may be brought into relation by assuming (*a*) that delayed response requires the mediation of a symbolic process and (*b*) that some of the vertebrates are capable of symbolic response to spatial but not to non-spatial cues. The latter assumption is strongly supported by the relative frequency and evident significance of spatial factors in the lives of most animals.

For present purposes a symbolic process may be conceived of as a differential, and usually implicit, response established by previous training, whose "meaning," as exemplified by its positive or negative valence, is extremely labile. The sign response is differential in the sense and to the extent that it varies for different stimuli. It is especially significant that unambiguous differential delayed conditioning has been reported only for cases in which the stimuli were spatially differentiated. In discriminational behavior, including delayed response, lability of the consequences of sign response is manifest by the readiness with which approach and avoidance may replace one another. This feature of symbolic behavior distinguishes it from all instances of habit acquisition, including delayed conditioning, in which the nature or direction of the overt response is fixed only after many trials and can be changed or reversed with difficulty. This characterization of symbolic process differs to some extent from all the many definitions proposed. It is less limited than most of them, more specific than some. In common with other conceptions of symbol, it exhibits relationships to language, the outstanding difference in this respect appearing in what Morris[6] designates as the "pragmatical dimension of semiosis." We are interested in the experimental and systematic consequences of the concept of symbolic process, not in the problem of terminology.

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[2] "Research—a National Resource," (1) "Relation of the Federal Government to Research," National Resources Committee, December, 1938.

[1] W. S. Hunter, *Jour. Genet. Psychol.*, 35: 380*ff*., 1928.

[2] S. D. S. Spragg, *Comp. Psychol. Monog.*, 13: 2, 38*ff*., 1936.

[3] R. M. Yerkes, *Comp. Psychol. Monog.*, 10: 1, 89*ff*., 1934.

[4] H. W. Nissen, A. H. Riesen and V. Nowlis, *Jour. Comp. Psychol.*, 26: 361–386, 1938. See also W. S. Hunter, *Behav. Monog.*, 2: 1, 1913, and *Psychol. Rev.*, 31: 478–497, 1924.

[5] J. T. Cowles and H. W. Nissen, *Jour. Comp. Psychol.*, 24: 345–358, 1937.

Inasmuch as it has been demonstrated[7] that delayed response in the absence of spatial cues is possible for young chimpanzees, but only after very extensive training, it seemed to us not improbable that mature individuals, with the advantage of more varied experience, might possess this ability in higher degree and consequently be capable of prompt adaptation. To test this possibility, a survey was made of the reactive capacities of members of the Yale chimpanzee colony.

Twenty-four individuals (19 adult, 5 adolescent; 4 male, 20 female) were tested in the summer of 1938 by the following procedure. After brief preliminary training of a subject, two rectangular wooden boxes, with hinged lids, the one painted white, the other black, were displayed before the animal and it was permitted to see a piece of apple placed in the box at its right. Thereupon the boxes were taken up by the experimenter and shifted in position relative to one another beyond the range of the subject's vision. They were then presented before the netting wall of the animal's cage in such manner that it could definitely indicate its choice by lifting the lid of one box. The food-containing or correct box might be at the right, left, above or below a central point, and the white and black boxes were used with equal daily frequency and in irregular, predetermined order.

At the outset the experimenter shifted the boxes by turning his back upon the subject. At first 2, and later 4, trials were given per day. Under these simple conditions most of the subjects were given 96 trials.[8] The interval during which a box was hidden from a subject was not more than 2 or 3 seconds.

During this phase of the investigation, individual differences in the pattern of response and degree of success were extreme. Thus some individuals tried to follow the boxes visually as they were being shifted; others did not. Some acted as if keenly interested, eager and expectant of success; others as if relatively indifferent or lacking confidence in their ability to secure the food. The percentages of correct response for individuals ranged from 44 to 99. The average for all individuals in a total of 2,183 trials is 65 per cent. The subject who succeeded best made only one mistake in 96 trials, although she apparently made no effort to follow the boxes visually or to maintain direction of attention or bodily orientation during the brief interval of delay.

On the basis of the above results, the 8 individuals with highest scores (99, 94, 90, 86, 81, 73, 72, 69 per cent. correct) were selected for further use. Each subject was given a series of 10 trials daily, with predetermined order of use of the white and black boxes and of the presentational position and relation of the boxes. Shift of the boxes was effected behind an opaque screen, and they were invisible to the subject during this process for not more than 5 to 8 seconds.

In their first hundred trials these 8 animals ranged from 44 to 58 per cent. correct choices. Success in daily series varied from 20 to 90 per cent. Six subjects were above 50 per cent. correct, the chance score.

Once more the most successful subjects were selected and the experiment continued with 5 individuals. There was no immediate change in procedure. Success varied between 57 and 64 per cent. in the second hundred trials. For the third hundred, effort was made to attract the attention of the subject to the correct box by holding it up to view after it had been baited and by pointing to it as the subject watched box and experimenter.

At the end of the third hundred trials the experiment was discontinued because of evidence of diminishing success and varied behavioral indications of increasing discouragement and frustration. Witness the percentages for the last hundred trials, which range from 43 to 63, and also the results for the total series of 300 trials when percentages are figured by successive groups of 50 trials: 47.8, 55.8, 59.6, 61.6, 51.6, 53.4.

The accompanying condensed table presents data for the 5 subjects (2 males and 3 females, aged 8 to 14 years) who were used in the preliminary stages of the investigation and throughout the 300 trials reported in the table.

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[6] C. W. Morris, "Foundations of the Theory of Signs," Univ. Chicago Press, pp. 29ff., 1938.

[7] H. W. Nissen, A. H. Riesen and V. Nowlis, *op. cit.*

[8] In 9 cases the trials varied between 45 and 95.

TABLE 1

Subjects	Average per cent. correct				Range in per cent.
	1–100 trials	101–200 trials	201–300 trials	Total	
Alpha	54.0	59.0	63.0	58.7	30–90
Bimba	54.0	57.0	61.0	57.3	30–80
Bokar	54.0	64.0	56.0	58.0	40–80
Frank	58.0	60.0	43.0	53.7	20–90
Lia	53.0	63.0	52.0	56.0	20–90
Total correct ..	54.6	60.6	55.0	56.7	
Total W correct.	52 0	57.2	54.0	54.4	
Total B correct.	57.2	64.0	56.0	59.1	

Behavior in these tests indicated adequacy of motivation, and as a rule diligence of effort to choose the correct box in order to obtain the food. There were many daily series in which success exceeded chance by 20 to 40 per cent., but in no case was perfection of response achieved, even for a single daily series. The degree of success exhibited, together with the behavior of the subjects in making their choices, convince us that some cue or cues, unobservable directly by us, were operative. Among them may have appeared symbolic process representative of white box or black box. But, if this occurred, it is clear that it did not function readily and smoothly, for the subjects obviously worked very hard to adapt to a situation which for the normal human being is extremely easy, and, moreover, they often were much disturbed emotionally. It appears that, whereas the "thereness" of the correct box may readily be responded to by the chimpanzee, the "thatness"—as exemplified by a symbolic process equivalent to rectangular whiteness—is used with difficulty and uncertainty. Nevertheless, it is our opinion, based upon the results of varied and long-continued training experiments, that symbolic processes occasionally occur in the chimpanzee; that they are relatively rudimentary and ineffective; and that our experiments with subjects ranging in stage of development from early childhood to maturity have supplied no convincing evidence of the increase in frequency and functional value of symbolic response with increase in experience and age.

In our findings we consider most significant the evidence that delayed response, in the absence of spatial cues or with misleading cues, is either extremely difficult or impossible for most chimpanzees. This suggests that we may have happened upon an early phylogenetic stage in the evolution of symbolic process. There is abundant evidence that various other types of sign process than the symbolic[9] are of frequent occurrence and function effectively in the chimpanzee.

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[9] C. W. Morris, *op. cit.*, pp. 17*ff.*, and E. A. Esper, chapter 11 in "A Handbook of Social Psychology," Clark University Press, pp. 426*ff.*, 1935.

SYNTHESIS OF ASCORBIC ACID IN EXCISED ROOTS OF THE WHITE MOONFLOWER

ASCORBIC acid is of very wide-spread occurrence in the roots of plants. The site of its synthesis constitutes a problem of considerable interest. Studies with intact plants are complicated by the possibility of transport from other organs. The answer to the question as to whether or not ascorbic acid is synthesized by the roots themselves can best be obtained by studies on excised roots.

Seeds of white moonflower (*Calonyction aculeatum*) were sterilized and germinated in darkness. When the radicles had attained a length of 2 to 4 cm the tips (1.5 cm long) were excised and transferred to flasks of nutrient solution. The composition of the nutrient solution was as follows: $Ca(NO_3)_2$ 0.0006 M; KNO_3 0.0008 M; $MgSO_4$ 0.00015 M; KCl 0.00087 M; $Fe_2(SO_4)_3$ 0.000006 M; $MnSO_4$ 0.000002 M; $Na_2B_4O_7$ 0.0000023 M; glucose 2 per cent. The cultures were kept at room temperature; one half of each set was exposed to diffuse daylight throughout the culture period, whereas the other was maintained continuously in darkness.[1]

Ascorbic acid determinations were made of samples of roots grown in the culture solution and of samples of seedling roots of the size and age of the original explants. The vitamin C content of the tissues was determined by a modification of the Tillmans method.[2] A combination of 8 per cent. metaphosphoric acid in 8 per cent. acetic acid was employed in extracting the juices.

Table I presents the results of three experiments involving 20 determinations on 132 cultures. Each value in the table represents an average of 2 to 4 tests. The data show that roots cultured in light contained approximately 4 to 10 times the quantity of ascorbic acid in the original explants, whereas those cultured in dark-

TABLE 1
ASCORBIC ACID CONTENT OF EXCISED MOONFLOWER ROOTS

C content of roots similar in age and size to original explants		Cultures in dark		Cultures in light		Culture period
mg/g fresh wt.	mg/root	mg/g fresh wt.	mg/root	mg/g fresh wt.	mg/root	(wks.)
0.135	0.0039	0.0263 0.0322 0.0292	0.0042 0 0038 0.0039	0.0638 0.1100 0.0984	0.0158 0 0398 0.0293	14 8 8

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[1] Facilities for the culture work were very generously made available by the Botany Department of the George Washington University. A detailed account of the culture technic will be published separately in Smithsonian Institution Miscellaneous Publications.

[2] R. R. Musulin and C. G. King, *Jour. Biol. Chem.*, 116: 409–418, 1936.

ness show no significant difference. Previous studies[3] with cow peas have shown that roots of plants grown with their shoots in the light contain several times as much ascorbic acid as those of plants grown in darkness.

The excised moonflower roots cultured in the light possessed a deep green color due to the presence of well-developed chloroplasts. For this reason a strict comparison can not be made between these light-grown cultures and the colorless roots of intact plants grown in the light. The excised roots grown in darkness may be more nearly comparable to the roots of intact plants, since both lack chloroplasts.

It has been observed[4] in other experiments with intact plants that roots with a relatively low content of ascorbic acid during a prolonged period of cloudy weather showed a marked increase of this substance following a day of bright sunshine.

Although the evidence is not conclusive, it seems probable that the increased quantity of ascorbic acid in the excised roots cultured in the light is due to the presence of well-developed chloroplasts. If this is true, it seems probable that the colorless roots of intact plants grown in the light do not synthesize vitamin C but receive their supply from the tops. It is planned to continue these studies, using excised roots which do not develop chlorophyll.

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A NEW MENINGOTOXOID

FOLLOWING the successful production of a toxin from gonococcus as well as a potent antitoxin against the same,[1] it was considered of interest to ascertain if similar procedures followed out with meningococcus might not also yield equally promising results. This note is merely to record briefly the method followed and the results obtained to date and is preliminary to a report to be made later.

THE METHOD

Ordinary broth having a pH of 7.7 was used. Two per cent. dextrose was added and the media distributed in quantities of 400 cc to diphtheria toxin flasks. It was seeded with an indigenous strain of meningococcus (No. 64) by planting a pellicle on the surface of the media. The culture was incubated at 37° C for 12 to 15 days until the surface growth or pellicle began to settle to the bottom of the flask. The broth culture was then filtered through Zeiss paper filters K and EK and the filtrate used for the first experiments. This filtrate was found to be so toxic that finally 3 to 4 per cent. of formaldehyde was added to it and then it was incubated at 40° C for 45 days. The toxin was then precipitated by adding 1.5 per cent. alum, the precipitate duly washed and finally dissolved by adding 4 per cent. sodium citrate. The toxoid thus obtained was used for the next series of experiments.

RESULTS

The unmodified toxin when injected into mice intravenously in quantities of 0.2 cc killed immediately; 1.0 cc injected intravenously into guinea-pigs was also lethal at once. The intradermal injection into guinea-pigs of 0.2 cc caused necrosis. This filtrate was thus observed to be of high toxicity. It also gave flocculation and precipitation reactions when tested with anti-meningococcus serum. Its antigenic properties in animals were found to be of a high grade. Repeated injections led to the development of antibodies, as proved by flocculation tests.

The filtrate treated with formaldehyde and then precipitated with alum afforded a much more satisfactory toxoid. This toxoid was much less toxic but retained all its capacity to elicit antibody formation. For instance, one month after the injection of a single dose of 1.5 of the alum-precipitated toxoid into rabbits the presence of antibodies in their sera was demonstrated.

In humans it was shown that consecutive injections of 0.5 cc, 1.0 cc and 1.5 cc of the non-precipitated toxoid or of 1.0 cc of the precipitated toxoid caused the formation of demonstrable antibodies in their sera.

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INCREASED SENSITIVITY OF HYPOPHYSECTOMIZED RATS TO RADIATION

IN a study of the metabolism of Na and K in relation to adrenal cortical physiology, we have administered radioactive isotopes of these elements to variously treated animals. We have been surprised to find that hypophysectomized animals could not tolerate these "tagged atoms" even in "physiological" doses (*i.e.*, 10 microcuries), while intact animals and adrenalectomized animals show no untoward effects from such doses.

Our attention was first called to this phenomenon in an experiment in which 10 hypophysectomized rats received approximately 10 microcuries of radioactive K and four such animals an equivalent dose of radioactive Na made up in a 1 cc isotonic solution and injected intraperitoneally. All the animals were dead within 48 hours. In a large series of normal rats to which the same dose of these radioactive isotopes had been administered, no ill effects have been observed.

We next selected ten animals which had been hypophysectomized thirty days previously and which were in satisfactory condition. Five of these rats were injected intraperitoneally with 10 microcuries of radioactive P in the form of 1 cc (15 mg) of an isotonic solution of Na_2HPO_4. The remaining five were given an equivalent dose of ordinary Na_2HPO_4. Within 48 hours after the injection of the radioactive P all five of the animals were dead, while the condition of the hypophysectomized controls remained unchanged.

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[3] Mary E. Reid, *Amer. Jour. Bot.*, 25: 701–711, 1938.

[4] Unpublished data.

[1] Gonococcus toxin and antitoxin, *Zentrabl. f. Bakt., Parisitenkun., u. Infektionskr.*, I Abt. Orig. 1939, Bd. 143.

The hypersensitivity of hypophysectomized rats to the injection of radioactive isotopes is in marked contrast to the response of adrenalectomized animals to similar doses of radioactive material. The major part of our experimental work in adrenal cortical physiology has been on adrenalectomized animals. We have injected radioactive Na and K into approximately 200 such animals and in no instance seen evidence of hypersensitivity to these substances.

Hypophysectomized rats are also more sensitive than normal animals to x-ray irradiation. Nine rats hypophysectomized three weeks previously were given 250 roentgens; this dose is well under the lethal dose for normal animals, which is approximately 700r.*; all the animals succumbed, but the median survival period was 10.6 days, as contrasted with a survival period of less than 2 days following the injection of radioactive isotopes.

It would seem established that hypophysectomized rats are abnormally sensitive to radiation, particularly when injected with radioactive isotopes, and it is to be noted that adrenalectomized rats tolerate radioactive isotopes at dose levels invariably fatal to hypophysectomized animals.

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University of California, Berkeley

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* The x-rays were generated by a 220 KV Maximar unit, which has been installed in the Crocker Radiation Laboratory through the generosity of the General Electric X-ray Corporation.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLE MECHANICAL THERMOREGULATOR

The regulation of temperature in a bath by controlled cooling, rather than by the usual method of controlled heating, is not a new principle,[1] but simple apparatus designed for precise temperature control has not been available hitherto. Advantages claimed for this regulator over the customary electrical type are comparable sensitivity at lower cost, with greater dependability and simplicity.

Since a small stream of cooling water is constantly introduced into the bath, an overflow or syphon is provided to maintain the level. If desired, a small coil of copper tubing may be used to provide the necessary heat transfer between the cold stream and the bath liquid, thus permitting the use of non-aqueous bath media.

A heater is used continuously, and may be of any type: immersion, lamp, steam coil or even a gas burner placed beneath the bath, provided it furnishes a steady heat input. Customary precautions should be taken to insure adequate stirring and insulation of the bath.

If variation in the pressure of the tap water (cooling water) prohibits the maintenance of a constant, steady stream to the regulator, a simple constant-pressure reservoir should be employed, furnishing water at one to three feet hydrostatic pressure.

The operation of the thermoregulator is self-evident from the sketch of Type 1. After bringing the bath to the desired temperature and removing excess mercury from the stem with a micropipette, if necessary, several minutes are allowed for equilibration of temperature within the regulator. Then with the mercury level below the orifice, D, in the stem, a steady stream of water is introduced into the top of the stem, its magnitude (controlled by screw-clamp, A) such that outlet C will easily handle it without overloading. Mercury is introduced into the stem from a micropipette until the orifice, D, begins to be occluded and water starts to flow into the bath through B. If the heat input to the bath is of the proper value, a steady stream of drops (or at most a thin stream of water) will hold the temperature stationary. Water must at all times be flowing simultaneously from both B and C when the bath is in equilibrium. The vent, E, prevents syphoning at C. Adjustment of the temperature to the last few hundredths of a degree may be done by varying screw-clamp A. When the bath temperature begins to fall, the regulator decreases the amount of water flowing into the bath, and *vice versa*. In permanent installations, screw-clamp A may be profitably replaced by a stopcock.

By reversing the connections at B and C, a supply of hot water entering at A will regulate the temperature of the bath through controlled heating.

Three types of bulb to be attached to the control

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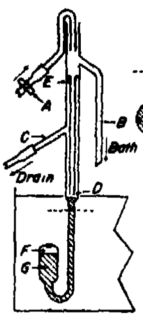
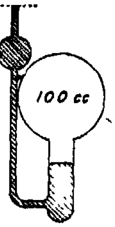
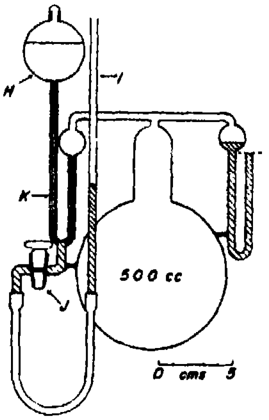
[1] D. F. Othmer, *Ind. and Eng. Chem., Anal. Ed.*, 3: 139, 1931; L. C. Beadle and F. A. Booth, *Nature*, 140: 279, 1937.



TYPE 1



TYPE 2



TYPE 3

head are shown below the dotted horizontal lines in the sketches. Type 1 is quite compact; the expansive medium is a liquid, F, with its vapor phase, standing over mercury, G, as shown. The liquid should boil 5–10° above the bath temperature (carbon disulfide is suitable for 35–40°), and a small bubble of air is included to preserve the vapor phase. The sensitivity of this type is about ± .01°, but a 5 mm change in barometric pressure may change the temperature 0.3°.

Type 2 is filled completely with a liquid of high coefficient of expansion, *e.g.*, ethyl acetate. It is not influenced by changes in barometric pressure; the sensitivity is ± .03°, but may be improved to ± .01° by inserting metal foil or wire gauze in the bulb.[2]

Type 3 is recommended for large baths where high sensitivity (± .003°) with ease of alteration of temperature setting is desired. The setting is changed by transferring solvent in the reservoir, H, to or from the expansion bulb through a capillary (1 mm internal diameter) bend, K, which is closed by mercury from the manometer, I, during operation. The stopcock, J, which sustains the mercury column, does not leak, since it only comes in contact with mercury. For quite large baths (100 liters), the diameters of the tubing used in the control head should be multiplied by one and one-half. A rubber sleeve is slipped over the water-filled portion of the control head immersed in the bath to prevent undesirable heat loss from the bath to the stem.

A. C. BRATTON

JOHNS HOPKINS MEDICAL SCHOOL

USE OF LATEX DRY ADHESIVE FOR KYMOGRAPH PAPER

SURFACES that stick fast to "themselves," but to nothing else, are familiar in envelopes where a turned-down margin separates the latex-treated flaps before use. Adhesion is immediate without moistening.

In the class laboratory we have found during two years' experience much satisfaction in the use of a similar method for wrapping kymograph cylinders. The liquid preparation can be rapidly applied with a brush to a large number of sheets. These are laid out on the bench so that each projects beyond the next a half-inch or more according to the circumference of the drum used, which must of course determine the appropriate coincidence. After drying in place, the set of sheets is inverted and the opposite ends are similarly treated. Stacked flat, the sheets can not adhere; but a sheet wrapped about the drum is firmly sealed in place by mutual contact of the prepared surfaces. The latex seal resists the heat of smoking and does not loosen, yet is readily separated for clean handling of the completed record. Sheets remain adhesive after months in storage. The method not only saves time for the student, but contributes distinctly to neatness in technique.

F. H. PRATT

BOSTON UNIVERSITY SCHOOL OF MEDICINE

BOOKS RECEIVED

FREUD, SIGMUND. *Moses and Monotheism.* Pp. 218 + vi. Knopf. $3.00.

GREEN, CHARLOTTE H. *Trees of the South.* Pp. xiv + 551. Illustrated. University of North Carolina Press. $2.50.

HARTNACK, HUGO. *202 Common Household Pests of North America.* Pp. 319. Illustrated. Hartnack Publishing Co., Chicago.

HENDERSON, I. F. and W. D. HENDERSON. *A Dictionary of Scientific Terms.* Third edition, revised. Pp. xii + 383. Van Nostrand. $7.00.

LINCOLN, FREDERICK C. *The Migration of American Birds.* Pp. xii + 189. 22 figures. 12 plates. Doubleday, Doran. $4.00.

SAUNDERS, E. R. *Floral Morphology; a New Outlook with Special Reference to the Interpretation of the Gynaeceum, Vol. Two.* Pp. xiv + 609 + vii. 48 figures. Heffer, Cambridge, England. 10s. 6d.

SEMAT, HENRY. *Introduction to Atomic Physics.* Pp. xv + 360. 147 figures. Farrar and Rinehart. $3.50.

SIMONS, LAO G. *Fabre and Mathematics, and Other Essays.* Scripta Mathematica Library, No. 4. Pp. v + 101. Yeshiva College, New York. $1.00.

THOMPSON, MAURICE DE K. *Theoretical and Applied Electrochemistry.* Third edition. Pp. xxi + 585. 234 figures. Macmillan. $5.00.

WALTER, HERBERT E. *Biology of the Vertebrates; a Comparative Study of Man and his Animal Allies.* Second edition, revised. Pp. xxv + 882. 736 figures. Macmillan. $4.00.

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[2] R. D. Stiehler, SCIENCE, 83: 40, 1936.

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SOME PROBLEMS OF AN EDUCATED MINORITY[1]

By Dr. OTIS W. CALDWELL

GENERAL SECRETARY, AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SCIENCE has been a constant factor in the education which has brought these young men and women to this, their graduation exercises. Science represents but one division of all the studies and experiences they have encountered. During most recent years their studies have been focused toward special careers, all scientific, broadly speaking. Previous to this specialization they and thousands of companions were engaged in what we call general education. To-morrow and afterward they look toward enployment in which they may use their general and their scientific education. Some have already found positions, others will find positions suitable to their training and ambitions. Some will not be so fortunate, if we may judge by the average results throughout American higher education. These average results are not primarily to be credited to or confused with current unemployment, but go to even deeper foundations in the American system of general and special education.

In this country we promise general education to all who wish it. Furthermore, we have laws which require that all young persons participate, so that those who do not wish education are more or less forcibly exposed to it anyway. Then, the educational system was asked to extend its years and to broaden its program so as to provide a living place for youth well toward their maturity. Some of these older youth are in educational institutions because they wish to be; some because they are nowhere else.

It is not news to any college administrator nor to the head of any professional college that the present educational situation causes many educationally drafted but hardly scholarly students to seek places in technical lines—medicine, law, teaching, accounting, even the ministry. Indeed, our generous system of scholarship aid, originally designed to enable superior young people to gain the education they might otherwise miss, has sometimes been used to encourage mediocre minds to aspire to professions for which native capacity illy fits them. America's slogan of "Educational opportunity for each person" has been misunderstood by some to mean that any person, by means of enough education, may rise to the top in any profession. Doubtless, we shall continue to believe in educational opportunity for all. Literacy and a measure of participation in constantly growing knowledge are worthy purposes for every fairly normal human being. But creative scholarship is for those who have potentially creative minds. It is an unsolved problem of how a system of universal education can secure for all the general education needed, without raising false hopes for many who are not likely to succeed in the more specialized professional callings.

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[1] Address at the graduation exercises of the Medical College of Virginia, June 6, 1939.

Some of the reasons for this dilemma are fairly clear. Hard physical labor by the many seemed unattractive when compared with what seemed to be the shorter hours, better and cleaner clothes and better pay of the professions. The shorter hours is a myth except for those who rise to less than the full measure of responsibility of the professions. There seems to be about as much card-playing, even bridge-playing, in one part of society as in another. Such things, in excess, are exponents of attitudes toward life rather than of mere quantity of education. If ease of living is one's major objective, higher professional education is hardly desirable.

Those now being graduated into higher scientific professions are welcomed into a fuller life, but not an easier life—a life in which well-intentioned mediocrity is not likely to be markedly successful. While the services of the sciences and arts are open to all who wish to know enough to enjoy them, the successful professional practice of the sciences and arts is open only to those of superior capacity, superior education and good social sensing of such callings.

The physician who cared for me during my childhood was a genius of his day. Let us not raise the question of whether he served society by helping me to live through the gamut of infectious diseases, then highly lethal, but now mostly under scientific control. That physician was almost self-educated. He read, rode and practiced under guidance of his predecessor of a still earlier generation. Whether his patients lived or died, he studied the results to guide him in subsequent cases. That doctor's fees were moderate though paid with difficulty and gratitude—sometimes paid mostly in gratitude. His house was the best in the whole community, his riding and driving horses the best, his advice and leadership gladly accepted by nearly all citizens. His occasional defeats by John Barleycorn were promptly forgiven by all except the preachers, who also forgave him when their next illness came upon them.

For this doctor's effective education, the community asked no return except the broad professional service which he gave. No one then thought of so-called socialized practice, which topic I shall not now discuss. But this truly educated man, hopelessly in the minority numerically, was almost a controlling factor in many aspects of community life.

In that early day there were but few successful physicians, and those, like other professional people, had little general education. The dentists always extracted offending teeth; any druggist was a pharmacist; the trained nurse had not appeared, and other professions were in similar stages of growth. Then, a system of public general education was developed, and slowly there came requirements of foundational education to precede specialization. To-day, we have the problem which arises from the tendency to rush through the years of general education toward the benefits of the special fields which can be reached only through higher and special education. We sometimes act as if we want to build the upper floors of our building without bothering much about the supporting foundations. Dean Le Baron R. Briggs, formerly of Harvard University, said:

> The university of today, carried away by its own development out of the college, has become dim-sighted toward two things: first, the relative importance of sound elementary training as compared with advanced scholarship, next the impossibility of advanced scholarship without such training. Few men can be original scholars; many may, by long and highly specialized work, become learned, and may find little to do with their learning when they get it. Tempting mediocrity to the higher learning has much to answer for. . . . No college ever made a man great; but many a college has helped a great man, and added efficiency to small ones.[2]

Minds of medium or average quality are far more common than are those either of *superior* or of *inferior* quality. But the ambition to participate in the superior intellectual callings is not limited to persons of superior minds. In a country in which education, even higher specialized education, is so nearly open to all, it is not surprising that so many teachers are illy prepared for teaching, that there are so many ordinary preachers, doctors, lawyers, dentists, nurses and pharmacists; that there occur so many well-meant but disappointing even tragic cases in practice by those who would have done better if they had been better.

"Oh," says our professional Pollyanna, "Look at the magnificent improvements that have been made." Yes, they are very wonderful and one of the justly claimed glories of our day. In mechanical appliances we live farther from our great-grandparents than were they from the Pharaoh king, Tut-Ankh-Amen. But the material achievements, which almost surpass our appreciation, strongly illustrate the unbalanced development of specialized knowledge and practice. It probably requires the highest possible type of mind and of education to discover, invent or in some way to secure a development of masses of people who will make unselfish and constructive uses of our material achievements. Too many high-speed automobiles, bought upon hopeful-partial-payment plans, rush irresponsible groups to luridly advertised objectives. from whose exciting blandishments another homeward rush is made in order to be back on time at any regular post, if there be one, where productive employment is had. Surely it is a major problem, for the educated minority, to find good and attractive ways in which specialized knowledge may do the most good and least harm to society as a whole.

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[2] L. R. Briggs, "Men, Women and Colleges," Houghton Mifflin and Company, 1925.

Times have changed greatly for most scientific professions, and other changes seem imminent. Since our whole educational system, including much higher professional education, has been opened to all and supported so largely by public expense and by endowment, as higher scientific training has become more costly, there has come increasing insistence that those with capacity to benefit from higher education owe part of their gains to the public. The problem is now presented as to whether education and the benefits therefrom belong wholly to any professional man.

An illustration of this is seen in the field of invention and patent rights. Highly trained and creative-minded men have discovered or devised mechanical improvements, new chemical combinations, new flower and food plants and plant products, and have secured patents covering their use. Patent rights have been issued upon many kinds of flowering and fruit plants and many thousands of mechanical devices and chemical and physical combinations. With new knowledge of chromosomes and genes, we may soon have patents not only on certain kinds of roses and hybrid corn as now exist, but might even have them upon milk cows and race horses. Accusations of infringement upon patents are constantly in the courts, based upon the legal right of those who secured the patents. Machines, medicines, books and all sorts of patented and copyrighted useful things are exponents of the growing stream of invention and creative work.

This problem directly concerns the discoverer or inventor, that is, a relatively small number of educated persons. It also concerns all people less directly, but no less certainly. And it is of tremendous import to present and future growth and use of knowledge.

We sometimes give too little attention to the fact that almost no great discovery, invention or combination of chemicals, of chromosomes or of physical forces is entirely new with the person or groups of persons who make the announcement. This fact does not lessen the importance of the announcement. Indeed, it increases its importance by showing that new things are usually merely additions to existing fundamental trends of thought and action. Adequate recognition of that which is new is desirable. But it is not desirable that a patent or copyright shall either allow the claimant to come into personal possession of the stream of thought of which his discovery is but one tributary or that his claim shall inhibit further discoveries of other tributaries which may later prove to be closer to the sources of the living springs of the whole stream.

Several persons and groups of persons in different nations had long been engaged in trying to make a vehicle which would operate without a horse to pull it. Success in this enterprise was almost simultaneously claimed by nearly a dozen independent workers. Similar principles and appliances appeared in all, as did dissimilar principles and appliances. Steam, gas and oil were each given a chance to supplant the inadequate horse. Although each worker doubtless wanted to know what others were doing, it seems likely that there was little actual stealing from one another. Rather, each worker had compassed the existing knowledge in the field and sought to add to it. The existing knowledge, in its previous development, showed the possible directions for the next steps, and independent workers sought to take those steps. That they took those steps almost simultaneously indicates some of the ways in which knowledge grows. To attempt to allow patent rights exclusively is to attempt to dam the huge stream of scientific thought. Such dams are soon undercut or washed aside, or the stream of advancing thought cuts around them.

The automobile also illustrates another phase of the problem. When it got started, vehicle-thinking was in terms of high wheels, narrow bodies, dashboards, buggy whips, high tops adjustable for rains and winds; and of roadways permitting a speed of four or five miles per hour. There was no need then of a club of drivers agreeing not to exceed 50 miles per hour. The first automobiles were little more than "horseless-carriages," named for the absence of the horse, resembling the old carriage which now operated while the unharnessed horse remained in the pasture. It required much constructive thinking, and will require much more, particularly in man's uses of it, to make a vehicle appropriate to the fundamental ideas of the automobile. Society is being taught to be uncomfortable when riding in an old model. Sales agents have learned the value of claims that new models include some of the sought-for added inventions. In fact, the patents now being granted upon new automobile inventions do not stop, but merely delay the competitors.

The fundamental problem of "Whose are the inventions and the products of higher learning?" is not likely soon to be solved, but there are significant trends toward solution. Many years ago the University of Wisconsin rendered assistance to Professor Babcock in his research regarding milk production. The milk-tester which he invented sent the star-boarder cow to the butcher, gave a diploma of merit to the cow which more than paid her way, and gave a bank balance to the dairyman who decided to become scientific. But Babcock assigned the invention to his state university, and thus to the state which cooperated in his research.

Since the Babcock assignment the Wisconsin Alumni Research Foundation has been organized. To this foundation, university faculty members are invited to assign any patents they may acquire, the inventor receiving 15 per cent. of any financial returns therefrom. The rest of the proceeds from such patents are used by the university for further scientific research. During the past ten years over one million dollars of such funds have been used by the Wisconsin Alumni Research Foundation.

Certain other educational institutions now ask staff members to make assignments of patent rights, with varying recognition of the personal interests of the inventor. Such institutions are the California Institute of Technology, the University of California, University of Cincinnati, Columbia University, Harvard University, Iowa State College, Cornell University, Lehigh University, Massachusetts Institute of Technology, University of Michigan, University of Minnesota, Pennsylvania State College, Purdue University, St. Louis University, University of Toronto, University of Utah, and possibly others.

Then, there are separate research foundations to which patents are assigned, such as the Bartol Foundation of Philadelphia, Carnegie Institution of Washington, Chemical Foundation, National Research Council and Research Corporation of New York. These receive assigned patents, let them out to approved manufacturers, give an agreed percentage of the returns to inventors, and use the major part for further research. In the main these are non-profit organizations interested in the advancement of science.

Another type of control and use of new ideas is found in many industrial research organizations. Many years ago the Mellon Institute of Pittsburgh was established to discover, develop and use new ideas in industry. A cooperating industry makes a research allowance to the institute. The research worker is paid a salary. His results belong to the donor of his salary. The donor may give a bonus to his research worker if he chooses when the results of the research are financially valuable. All discoveries and resulting patents belong wholly to the donor of the research salary. Thus, the education, the labors and new ideas of the worker belong to the donor. Discoveries may be kept secret indefinitely if the industrial donor so desires.

At the other extreme is the policy of the Rockefeller Institute of Medical Research, which says all discoveries "are made freely available to the public. . . . Other than through the issuance of license, the Rockefeller Foundation does not participate in any way in the commercial preparation or sale of the manufactured chemicals; and it receives no royalties or other pecuniary benefits from the license it issues."[3]

A highly important corollary problem concerns new knowledge, discovery and invention in their relation to human employment. There is a wide-spread belief that new knowledge, as shown in new devices, destroys work opportunities. Scientific achievements are accused of removing workers from their jobs. The soap-box orator can point to the steam shovel in a building excavation and make his point by saying, "It is doing the work of twenty men." A mechanical wheat harvester was burned in my home county because laborers claimed it had lost them their wages. Yet even now, farmers can not secure adequate man power, at increased wages, to accomplish their tasks. What are the facts?

It is obvious that invention has reduced the quantity of demand for certain types of labor, and at the same time has changed the quality of labor needed.

In a recent address before the Florida Academy of Sciences, Dr. Allen presents figures which are illuminating. In the United States there are at least 18 major industries which were "entirely unknown 50 years ago."[4] During the past 50 years while our population has increased "118 per cent., the proportion of employed persons in the population increased 191 per cent." In Manhattan, New York, "there are now four times as many ways of earning a living as existed a quarter of a century ago." The manufacture and sale of transportation machinery now employs approximately ten times as many men as in 1900 were employed as "blacksmiths, stable operators, teamsters, harness workers and wagon and buggy builders." The electric refrigerator has stopped the daily trek of the ice man into the kitchen, and our 10,000,000 refrigerators demand more and better trained workers than previously handled ice. These operations now use tremendous quantities of products from farms, forests and mines, thus very greatly increasing the market for agriculture, forestry, mining and other productive enterprises.

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[3] "The Rockefeller Foundation—A Review for 1938," Raymond B. Fosdick, 1939.

[4] Robert I. Allen, "Science versus Unemployment," SCIENCE, 1939.

This is not the proper occasion for further citation of such facts, but is the occasion for directing attention to the significance of such facts in relation to fundamental problems of our day. Persons who have had the benefits of higher education are needed as informed leaders. Instead of accepting and contributing to the disquiet of misunderstanding, instead of encouuraging the wishful thinking about the good old days, which can not come again, we need to redirect education in accord with the difficult but better present day and those which we should like to believe may be ahead of us.

The highly educated minority seems to be close to the crossroads in the progress of higher learning. Their leadership in thought and practice can continue only as they find effective ways to distribute useful knowledge and service and to lead the majority toward sympathetic participation in advancing knowledge. The mass of knowledge-consumers and users, even though they are not primarily discoverers, now need, and sometimes expect or demand, enough insight into new knowledge that they may appreciate its significance.

The older idea was based upon an authority possessed by the leader, who was an inventive scientist. But in our country, authority of persons as such will rapidly diminish. Known and demonstrable truth must be the final authority. They told Louis Pasteur in 1881 that he could not prevent anthrax in cows and sheep by his claimed vaccination. What authority did he use in proving his case? He said: "Provide cows and sheep for a public demonstration and we shall see the truth." On May 5, 1881, he vaccinated 6 of the 10 cows and 25 of the 58 sheep. Four cows, 23 sheep and 2 goats and 10 control sheep were not vaccinated. On May 17, 1881, the same sheep and cows were again vaccinated. On May 31, 1881, all cows and all sheep except the 10 control sheep were given fully virulent anthrax germs. On June 2, 1881, all unvaccinated cows, sheep and goats, except the 10 controls, were dead or severely ill. The truth was demonstrated and accepted.

Not only the material benefits from modern knowledge, but the science man's way of working need to be more fully understood and more widely used. Pasteur did little arguing. He presented truth and demonstrated the meaning of truth. He withheld nothing for himself. He sometimes expressed regret that so many uninformed people could not, or did not, wish to understand, but he found encouragement from those who did understand.

One of the biggest, probably the biggest, problem for an educated minority is that of extending the way of working, which is characteristic of discoverers, the real desire to know and use proved knowledge. Much has been said about this, but not enough has been done.

Man's inquiring and daring mind is a scientific fact of the greatest significance. Man is an adventurous animal, always attempting something which no one has yet succeeded in doing. At his best, man always wants to do something for society which has not yet been accomplished. His worthy curiosity is a catalyst by which new knowledge and new services may come to society.

Whose is modern knowledge? Is it the property of such workers as the scientist? The administrator? The practitioner? The inventor? The manufacturing industrialist? Or is it held in trust by the better educated, but with the unavoidable obligation that all may be led into its benefits?

Surely, society has the right to expect the educated minority to be its sure-footed leaders, rather than that their superior education may be used by them merely to gain increased personal benefits through exploitation of their advantages.

The creative scientist, the scientific practitioner, the trained social worker, the educator, indeed all those who have benefited through higher education, have their largest, the most difficult and the best task still to be met.

OBITUARY

ELMER PETER KOHLER

THE following minutes were placed upon the records of the Faculty of Arts and Sciences of Harvard University at the meeting of February 14, 1939:

ELMER PETER KOHLER

Sheldon Emery Professor of Organic Chemistry

Elmer Peter Kohler was born on November 6, 1865, in the village of Egypt, Pennsylvania. His immigrant ancestor, Jacob Kohler, from Mühlhausen in Switzerland, in 1728–30, was the first settler in the vicinity of Egypt and acquired there a large tract of fertile land by warrants from the Penn Heirs. Through succeeding generations the Kohlers remained in Egypt as prosperous farmers, millers and merchants.

Elmer grew up on the ancestral farm and in the ancestral mill, profiting greatly from the education that they afforded. An alert, venturesome, self-reliant boy, unusually observant and thoughtful, he made botanical and mineralogical collections and learned the peculiarities of plants and the ways of animals. In the mill and among the farm machines which his progressive father installed he developed that mechanical skill which proved so useful to him in his later life. Above all, and by much hard work, he mastered the science and the practice of farming.

In 1886 he graduated, with honors, from the classical course at Muhlenberg College, in nearby Allentown. Shortly thereafter he journeyed West to seek his fortune and became a Special Passenger Agent on the Santa Fé. He was successful in this work and liked it, particularly the trips all over the Southwest, but he soon longed for wider intellectual horizons and in 1888 returned to Muhlenberg for another year of study.

At this time, through his own reading rather than by formal instruction, his interest in chemistry was awakened and in the following year he went to Johns Hopkins University to study organic chemistry under Ira Remsen. Johns Hopkins was then the Mecca in our country for those interested in the advanced study of this subject. Kohler developed rapidly in this environment and though previously untrained in chemistry obtained his doctorate in three years (1892).

Appointment to an instructorship at Bryn Mawr promptly followed and he was the first to teach organic chemistry at that institution. There he won recognition as a stimulating lecturer, an efficient teacher and a productive scholar. He soon became influential in the college at large and was recognized as the informal counsellor of the president, M. Carey Thomas, whose robust and discerning personality had so much in common with his own.

In 1912, after twenty fruitful and happy years at Bryn Mawr, Kohler came to Harvard to give the courses in elementary chemistry and in advanced organic chemistry, previously given by Charles Loring Jackson and Henry B. Hill, respectively. In 1914 he was appointed Abbott and James Lawrence Professor.

Kohler's academic career was interrupted in 1918 when he was granted leave of absence to assume the direction of research in the Offense Section of the Chemical Warfare Service of the United States Army. There, thanks to his broad knowledge of applied as well as theoretical chemistry, his good sense and his active and resolute leadership, he soon rescued this branch of the army's work from the confusion in which he had found it and made it a conspicuous success. He returned to Harvard in the fall of 1919.

Kohler's mature wisdom, keen insight and inveterate fairness were recognized at Harvard as they had been at Bryn Mawr and he was called upon to serve on many important committees. He was a member of the Administrative Board of the Graduate School for many years and in 1926 was Acting Dean of that School during the absence of Dean Chase. In 1934 he was appointed Sheldon Emery Professor of Organic Chemistry and in the same year he took over the chairmanship of the Department of Chemistry.

Kohler was in the full tide of his multifarious activities as investigator, teacher and administrator when he was overtaken by his brief, final illness. He died on May 25, 1938.

Kohler was preeminently an investigator, and as such was outstanding both in the extent and in the quality of his achievements. Arriving at Bryn Mawr young, inexperienced and isolated, he promptly began a long succession of significant, carefully planned, skilfully executed and elegantly reported experimental investigations in his chosen field of organic chemistry. In some of the experimental work he was assisted by able young women students whom he had himself trained, but most of his researches were carried out entirely with his own hands. At Harvard, in spite of his numerous duties as teacher, committeeman and administrator, his scientific productivity increased. He had, of course, many more collaborators and assistants than at Bryn Mawr, but he continued unremittingly his own personally executed investigations. Indeed, one searches in vain for any chemist in recent times who has turned out so great a quantity of experimental investigation performed with his own hands. He was a virtuoso in the experimental art. He had an encyclopedic knowledge of his whole field, keen insight and sound judgment.

Kohler possessed phenomenal powers of observation which functioned not only in his work but in all his daily contacts. A walk in the country or through city streets yielded him a surprising amount of information and his memory was unusually retentive. To the end of his life the physical minutiae of his observations as a lad on the farm or of his youthful experiences in the Southwest were as fresh as though they were of yesterday.

Most remarkable of all was the continued flexibility and freshness of his mind. He was always abreast of the times and to the last was as receptive and sympathetic to new ideas as the most enthusiastic youngster. His mental as well as his physical vigor was maintained undiminished up to his last brief illness.

Kohler was a great teacher. His skill as a lecturer and his wide, first-hand familiarity with the everyday applications of chemistry to agriculture, to industry and to physiology brought him success in Chemistry A, the introductory course in general chemistry. His astonishing grasp of the bewilderingly multiplex and protean science of organic chemistry and his flair for simple and lucid presentation established his Chemistry 5 as a veritable masterpiece famous among organic chemists the country over.

More important, however, than his activities as a lecturer were his daily associations with his students in the laboratory. It was here that he left an indelible imprint. A thorough training in organic chemistry was the immediate goal of his teaching, but diligence, forethought, independence, enterprise and integrity were his more fundamental objectives. Practicing what he preached, a zealot in his science and a master of his craft, he taught as much by example as by precept. Truly Spartan in his own life, Kohler scorned sentimentality and always told the simple truth as he saw it, no matter how unpalatable it might be. Firm, courageous and indomitable, he was a wise and kindly counsellor and a loyal friend.

ARTHUR B. LAMB, *Chairman*
LIONEL S. MARKS,
LAWRENCE J. HENDERSON,
Committee

RECENT DEATHS AND MEMORIALS

DR. ARTHUR EDWIN KENNELLY, professor emeritus of electrical engineering at Harvard University and at the Massachusetts Institute of Technology, died on June 18 at the age of seventy-seven years.

DR. GEORGE ELWOOD NICHOLS, professor of botany and director of the Botanical Gardens at Yale University, died on June 20 at the age of fifty-seven years.

EDWARD K. PUTNAM, director of the Davenport Public Museum, Iowa, died on May 22 at the age of seventy years. Mr. Putnam entered the service of the museum, at that time called the Davenport Academy of Sciences, in 1906 as acting director and served continuously until his death, becoming director in 1927. He has been the principal benefactor of the museum and was managing director of the William Clement Putnam estate trust, which was set up for its support.

CHARLES NEWELL COBB, supervisor of science instruction for the New York State Education Department for thirty-four years until he retired in 1927, died on May 6. He was eighty-four years old.

THE death is announced of Dr. Karl von Auwers, professor of chemistry at Marburg, and of Dr. Hans Böker, professor of anatomy at Cologne.

IN announcing the death of Professor Edwin Linton in the issue of SCIENCE for June 9, the date was incorrectly given. He died on June 4.

IN the vestibule of the new Dunning Science Building, which is in course of erection at Washington College, Chestertown, Md., there will be placed carved marble plaques of Ira Remsen, from 1876 to 1913 professor of chemistry of the Johns Hopkins University and president of the university from 1901 to 1913, and of John Jacob Abel, from 1893 to 1938 professor of pharmacology at the Johns Hopkins University. The plaques represent each in relief, with tributes to their work carved in the marble.

IT is reported in *Nature* that the centenary of the birth of Théodore Ribot and the jubilee of the foundation of the chair of experimental psychology in the Collège de France, of the Laboratory of Physiological Psychology at the Sorbonne and of the thesis, "L'Automatisme psychologique," submitted by Pierre Janet, would be celebrated by a gathering at the Sorbonne on June 22, under the presidency of the Minister of National Education. Among those taking part were Professor P. Janet and Professor H. Piéron, who succeeded Binet as director of the laboratory at the Sorbonne. A jubilee volume, in which many psychologists are collaborating, is to be published in honor of Ribot, Binet and Janet, who were the pioneers of scientific psychology in France.

SCIENTIFIC EVENTS

THE SIXTH INTERNATIONAL CONGRESS FOR EXPERIMENTAL CYTOLOGY

THE sixth International Congress for Experimental Cytology will be held at Stockholm from July 25 to August 1, 1940. The following preliminary program has been arranged by the Swedish organization committee, the president of which is Professor John Runnström, and the secretary Dr. Sven Hörstadius, whose address is Wenner-Grens Institut, Norrtullsgatan 16, Stockholm. For each topic, review papers given by invited speakers will be read at the general sessions. Discussion of the papers will follow. Four afternoons will be devoted to demonstrations and to the remaining papers submitted. The preliminary program follows:

July 25: Opening of the congress. Rhoda Erdmann Memorial Lecture.

July 26: Proteins: their structure and rôle in biological processes. The physical analysis of protoplasmic structure: x-rays; double refraction. The electron microscope. Viruses.

July 27: Surface films and their properties. The problem of permeability. Electro-physiology of the cell. Demonstrations.

July 29: Cell metabolism. Demonstrations. Miscellaneous short papers.

July 30: Morphology of the cytoplasm. Protoplasmic changes during physiological activity. Demonstrations. Miscellaneous short papers.

July 31: The nucleus and cell division. Sexual substances (fertilization substances) of the gametes, their chemical nature and their genetical control. Demonstrations. Miscellaneous short papers.

August 1: Cell physiology and development. Normal and abnormal growth. Tissue culture.

The program outlined has been developed from the point of view of cellular physiology. It is pointed out that the conventional distinctions between physical chemistry, biochemistry and cellular physiology have at present no sharp borders, and that place has been reserved for physico-chemical discussions of the behavior of the components of protoplasm.

The Swedish committee hopes that there will be at this congress ample opportunity for fruitful contact between experimental cytologists and workers in related fields. Opportunities will, however, be provided for the arrangement of informal afternoon sessions wherein smaller groups may enjoy unrestricted discussion. The membership fee has been fixed at twenty-five Swedish crowns.

BRITISH HONORS

From the list of honors arranged on the King's birthday *Nature* selects the following men of science and others associated with scientific work:

Baronet: Dr. R. Hutchison, president of the Royal College of Physicians; *K.B.E.:* Professor W. B. Benham, emeritus professor of biology, University of Otago, Dominion of New Zealand; Professor T. A. Hunter, professor of philosophy and psychology, Victoria College, University of New Zealand; the Honorable P. H. Rogers, judge of the Supreme Court and chancellor of the University of Sydney. *Knights Bachelor:* Dr. E. J. Butler, secretary to the Committee of the Privy Council for Agricultural Research and secretary to the Agricultural Research Council; F. Carnegie, chief superintendent of Ordnance Factories, War Office; Dr. R. E. Kelly, professor of surgery, University of Liverpool; Professor J. Graham Kerr, M.P. for the Scottish Universities since June, 1935, formerly regius professor of zoology in the University of Glasgow; Professor O. W. Richardson, Yarrow research professor of the Royal Society, University of London; Professor J. F. Thorpe, chairman of the Smoke Sub-committee, Chemical Defense Committee, War Office, emeritus professor of organic chemistry in the University of London and in the Imperial College. *C.I.E.:* C. E. C. Cox, chief conservator of forests, Central Provinces and Berar; H. R. Stewart, director of agriculture, Punjab; E. A. Smythies, chief conservator of forests, United Provinces; W. J. Jenkins, officiating director of agriculture, Bombay. *C.B.E.:* A. S. Cox, assistant comptroller, Patent Office, Board of Trade; Seton Gordon, for services to literature and natural history; C. E. Legat, for services to the Empire Forestry Association; G. M. Mathews, a prominent ornithologist, for services to the Commonwealth of Australia; J. P. Mead, director of forestry, Straits Settlement, and adviser on forestry, Malay States; Professor E. J. Salisbury, Quain professor of botany, University of London; R. J. L. V. Sukuna, district commissioner and chief assistant, Native Lands Commission, Fiji. *O.B.E.:* E. J. Bruen, livestock expert to the Government of Bombay; Dr. G. P. Douglas, assistant superintendent (research), Royal Aircraft Establishment, Farnborough; Dr. W. E. Fisher, principal, Wolverhampton Technical College; Professor W. G. R. Paterson, principal and professor of agriculture, West of Scotland Agricultural College, Glasgow; H. F. Mooney, forest officer, Eastern States Agency, India; J. Sinclair, for services to agriculture in the Nyasaland Protectorate; A. A. Topp, manager of the Government Explosives Factory, Maribyrnong, Commonwealth of Australia; J. Turner, forestry officer, Department of Natural Resources, Newfoundland. *M.B.E.:* B. M. Cameron, manager, Government Stock Farm and Agricultural Station, Acre, Palestine; A. P. Dodd, chief entomologist to the Prickly Pear Board, Commonwealth of Australia; W. M. Findlay, superintendent of experiments and lecturer in seed testing, North of Scotland College of Agriculture; Miss E. A. Leighton, accountant, Building Research Station, Department of Scientific and Industrial Research; A. F. MacCulloch, advisory chemist, Medical Store Depot, Madras; T. K. Mirchandani, officiating deputy conservator of forests, Bombay; Miss U. F. M. Morton, principal, Women's Medical School, Agra, United Provinces; K. R. N. Pillai, extra assistant conservator of forests, Jubbulpore, Central Provinces and Berar; H. G. Smith, statistician, Agricultural Department, Uganda Protectorate. *I.S.O.:* J. M. Dunbar, assistant and office superintendent, Department of Agriculture, Gold Coast.

STEPHEN TIMOSHENKO—SIXTIETH ANNIVERSARY VOLUME

The arrival of Timoshenko in 1922 has proved to be a significant event in the development of engineering in the United States. There was, at that time, a lack of engineers competent to deal with the vibration problems which were arising as a result of the increasing use of high-speed machinery, the stability and buckling problems which resulted from the endeavor to make structures lighter by the use of thin walls and other similar problems in the general field of applied mechanics. To meet this need adequately it was necessary to have, in one person, a great scientist and a great teacher. Timoshenko has filled this need in full measure.

Associating himself with the Westinghouse Electric and Manufacturing Company in 1923, he found at East Pittsburgh an unusually able group of graduates of engineering schools. The majority of these had been subjected to a four-year course in engineering of the then familiar pattern and had acquired only the most elementary knowledge of mathematics and applied mechanics. Timoshenko, a born teacher, gathered these fledglings under his wing, without any official prompting or assistance, and proceeded to educate them. He became a peripatetic university for the group. Sunday mornings saw a practical exemplification of the legendary activity of Mark Hopkins in the woods and fields around East Pittsburgh. The intellectual horizon of the disciples was rapidly extended because of the close integration of their discussions with their work problems. In the interval from 1923 to 1927 there was enacted one of the most striking educational developments of our times. The men who were in that group are now among our most prominent professors of applied mechanics and our most able engineers.

The influence of Timoshenko was by no means limited to his immediate disciples. His long array of books and papers dealing with many of the new problems in civil and mechanical engineering had already made him known as a pioneer and his stream of publications has continued uninterruptedly. In a short time he was universally accepted as the leader in those fields with which he dealt. His appointment to a professorship in applied mechanics in the University of Michigan in 1927 established a new center of influence and attracted not only graduate students but also teachers and practicing engineers. His genial personality tied his students and associates to him with a bond of deep affection.

It is small wonder that the occurrence of Timoshenko's sixtieth birthday was seized upon as an opportunity for a demonstration of gratitude, respect and affection, not only by those who had studied under him or had otherwise been associated with him, but also by other engineers of distinction who worked in the field of applied mechanics. The leaders in this field in other countries—in England, Germany, Holland and Turkey—were not to be denied the opportunity of joining in this demonstration.

The "Sixtieth Anniversary Volume of Contributions to the Mechanics of Solids" which was presented to Timoshenko at his birthday dinner contains contributions from thirty scientists. The contributors include Prandtl, G. I. Taylor, von Karman, Southwell, Biezeno, Westergaard, Nadai, Den Hartog, von Mises and other recognized leaders. Their papers cover such problems as buckling, vibration, friction, fatigue, elasticity, dynamic stability, stress analysis, creep and plasticity. The book is a serious contribution to the solution of many problems in the mechanics of solids.

Lionel S. Marks

Harvard University

DOCTORATES OF SCIENCE CONFERRED BY YALE UNIVERSITY

Yale University on June 21 conferred the degree of doctor of science on Dr. Hans Zinsser and on Dr. Ross Granville Harrison. The remarks made by Professor William Lyon Phelps, public orator of the university, in presenting the candidates, and the citations of President Charles Seymour, in conferring the degrees, follow:

Hans Zinsser, Sc.D.

Professor Phelps:

After graduating from the School of Medicine at Columbia in 1903, Dr. Zinsser began his lifelong uncompromising war against infectious diseases. Within seven years he had attracted the attention of experts; and was called across the United States to be professor of bacteriology at Stanford University. Three years later Columbia recaptured him and in 1923 he made the Northeast Passage, unfortunately not stopping at New Haven, and became professor of bacteriology and immunology in the Medical School at Harvard.

But the Western Hemisphere was not large enough either to provide sufficient material for research or to contain his rapidly growing reputation. Like Scipio, he carried the war into Africa and later into the Far East. His textbook has been translated into Chinese.

During the World War, he was a member of the Red Cross Sanitary Commission to Serbia and with the rank of colonel he had charge of laboratories to protect the health of American soldiers. He received the Distinguished Service Medal, and his manual for the sanitation of a field army is a model.

Meanwhile his researches continued with unabated energy. Two of his works have served as excellent guidebooks for medical students, physicians and public health officers.

He made an aggressive attack on the dreaded typhus fever, a scourge always accompanying war and famine. He isolated and manipulated the germ of typhus called Rickettsia, and from it succeeded in preparing a protective vaccine. By careful experiments often at personal risk, he has done more than any other investigator to clarify the various forms of these protean diseases, recognizing them in their deceptive disguises. A few years ago Dr. Zinsser gave some of the results of his studies in popular language through his exciting book "Rats, Lice, and History." With impressive logic relieved by original humor he showed the effects of man's poor relations among animals and insects; and this book has not only influenced investigators; it has been profitably consulted by historians.

He is one of the foremost laboratory scientists; and in the midst of his war against disease he has made friends everywhere in the world; his chronic courage is salted with humor; for although he is a medical philosopher, we may say of him what Edwards said to Johnson, "cheerfulness is always breaking in."

President Seymour:

Brilliant in the most daring and dangerous investigation, unmatched in color and clarity of exposition, master of detailed analysis and utilizing a wealth of humanism to enrich and illumine your scientific synthesis, Yale confers upon you the degree of Doctor of Science and admits you to all its rights and privileges.

Ross Granville Harrison, Sc.D.

Professor Phelps:

In 1907 a very good thing happened to Yale. Dr. Harrison came hither as Bronson Professor of Comparative Anatomy. The chair was well named, for he had been teaching first at Bryn Mawr, and then at Johns Hopkins. Equipped with a Johns Hopkins Ph.D., and also a charming wife and an M.D. degree acquired at Bonn on the Rhine, the Sheffield mansion became his workshop and the house afterward called Mory's his home. In a few years he created the first university department at Yale, with the perilous honor of serving on both the Sheff and academic faculties as well as those of the Graduate School and the School of Medicine. He planned the Osborn Memorial Laboratories.

His classic papers on the development of the lateral line and the muscle nerve relationships in the frog focussed the attention of American scientists. When the arguments concerning the origin of peripheral nerves had reached a stalemate Harrison answered the question by growing the nerve tissues outside the body. This brain child, known as Tissue Culture, has grown to gigantic size. It is a method universally applied to living systems and to the solution of fundamental problems in both biology and medicine.

As an investigator he is known for his complete, critical and thorough attack upon the very heart of a problem. The experiments are perfectly planned and executed. In his teaching he has been the advocate of the "Sink or

Swim" method as a result of which his scientific progeny in this country occupy many of the key posts. Strength has produced strength.

His honesty and integrity as man and scientist have received universal commendation. His scientific career has justly secured recognition throughout the world. He bears his honors with simplicity. In all ways he is genuinely and affectionately known wherever biologists are gathered as "*The Chief.*"

In all his honors he has shown the modesty, simplicity and kindness to those less gifted, which are characteristic sometimes of great minds. Retired from the field of active teaching, he gives his full time to research. He carries with him the affection and the respect of all members of the Yale Brotherhood.

President Seymour:

Revered and beloved leader, eminent scholar, selfless and inspiring personality, for the services you have rendered to this university in its laboratories, its schools of the arts, science, medicine—undergraduate and graduate—for your investigations and discoveries, and for the example you have given to American universities as the perfect scientist, Yale honors herself in conferring upon you the degree of Doctor of Science, admitting you to all its rights and privileges.

SCIENTIFIC NOTES AND NEWS

THE doctorate of science of Harvard University was conferred on June 22 on Dr. Percy W. Bridgman, on Dr. Charles F. Kettering and on Dr. Hans Zinsser. President Conant made citations as follows: Percy W. Bridgman, Hollis professor of mathematics and natural philosophy, Harvard University—"An experimentalist who transforms stubborn matter by high pressures; a logician who alters physical theory by acute analysis." Charles F. Kettering, engineer, president of General Motors Research Corporation, Dayton, Ohio—"An engineer in the great American tradition, an inventor whose imagination has quickened both industry and science." Hans Zinsser, Charles Wilder professor of bacteriology and immunology, Harvard University—"A dynamic teacher whose vision extends beyond his laboratory; a famed investigator of the secret ways of man's microscopic enemies."

COLGATE UNIVERSITY, at its one hundred and eighteenth commencement on June 12, conferred the doctorate of laws on Dr. Charles August Kraus, professor of chemistry at Brown University, president of the American Chemical Society.

THE University of Pennsylvania, on June 20, conferred an honorary doctorate on Dr. Joel H. Hildebrand, professor of chemistry at the University of California.

BROWN UNIVERSITY conferred on June 19 the doctorate of laws on Dr. Vannevar Bush, president of the Carnegie Institution of Washington, previously dean of engineering and vice-president of the Massachusetts Institute of Technology.

AMONG the honorary degrees conferred at the one hundred and seventieth annual commencement exercises at Dartmouth College on June 18 was the doctorate of science on Charles Franklin Kettering, president of the General Motors Research Corporation.

THE University of Rochester conferred honorary degrees on June 19 on Dr. Peter Henry Buck, director of the Bishop Museum, Honolulu, and on Dr. Philip A. Shaffer, dean of the Medical School of Washington University, St. Louis.

THE honorary degree of doctor of public health has been conferred by New York University on Dr. Sigismund S. Goldwater, commissioner of hospitals of New York City.

THERE was held at the University of Sofia, Bulgaria, from May 20 to 26 a celebration of the fiftieth anniversary of its foundation. On this occasion there were named ninety-two doctors *honoris causa* for outstanding achievement in various scientific and other directions. Of these the following were from America: Professor G. D. Birkhoff, Professor Claude Burton Hutchison, Professor Vladimir N. Ipatieff, Professor Albert Russell Mann, Professor William F. Russell, Professor Joseph Alois Schumpeter and Nikola Tesla.

THE Theobald Smith medal and prize of $1,000 has been awarded by the American Association for the Advancement of Science to Dr. Albert B. Sabin, of New York City, associate of the Rockefeller Institute for Medical Research, in recognition of his work on pneumococcus infections.

THE Society for the Promotion of Engineering Education on June 21 awarded the Lamme Medal for achievement in engineering education to Dr. Stephen Timoshenko, professor of mechanical engineering at Stanford University.

THE Lord Mayor of London, on behalf of British foundrymen, on June 14 presented a gold medal to Dr. T. A. Schwartz, research manager for the National Malleable Steel Casting Company, of Cleveland, for his research contributions to the progress of the foundry industry. Dr. Schwartz at the time was in London to attend a meeting of the International Foundry Congress.

THE Albert Medal of the Royal Society of Arts for 1939 has been awarded to Sir Thomas H. Holland, principal and vice-chancellor of the University of

Edinburgh, in recognition of "his services to the mineral industries." The Albert Medal was established in 1862 as a memorial of the Prince Consort, who was for eighteen years president of the society. It is awarded annually for "distinguished merit in promoting arts, manufactures or commerce."

THE trustees of the Academy of Natural Sciences of Philadelphia have elected as corresponding members: Professor W. C. Allee, University of Chicago; Dr. Glover M. Allen, Museum of Comparative Zoology, Cambridge; Professor F. Baltzer, Zoological Institute, Bern; Dr. R. S. Bassler, United States National Museum; Dr. Albert F. Blakeslee, Carnegie Institution of Experimental Evolution; Dr. Willis S. Blatchley, Indianapolis; Professor Maurice Caullery, Paris; Dr. Lucien Chopard, Museum d'Histoire Naturelle, Paris; Dr. Hubert Lyman Clark, Museum of Comparative Zoology, Cambridge; Dr. J. A. Cushman, Sharon, Mass.; Professor Theodosius Dobzhansky, California Institute of Technology; Dr. F. E. Fritsch, East London College; Professor Jesse M. Greenman, Missouri Botanical Garden; Professor G. D. Harris, Ithaca, N. Y.; Dr. Wilhelm Michaelsen, Hamburg Museum; Dr. James P. Chapin, American Museum of Natural History; Professor A. S. Pearse, Duke University; Dr. Andeas Petrovitch Seminov, Leningrad; Dr. A. H. Westergaard, Geological Survey of Sweden.

HAROLD J. COOLIDGE, JR., has been elected an honorary member of the Cercle Zoologique Congolais, in recognition of his work on the fauna of the Congo.

DR. PATRICK MARSHALL, professor of geology at Otago University, New Zealand, has been made president-elect of the Australian and New Zealand Association for the Advancement of Science for the Adelaide meeting to be held in August, 1940.

AT the St. Louis meeting of the American Society for the Study of Allergy, officers for the coming year were elected as follows: *President,* Warren T. Vaughan, Richmond, Va.; *President-elect,* Robert L. Benson, Portland, Ore.; *Vice-president,* Milton B. Cohen, Cleveland, Ohio; *Secretary-Treasurer,* J. H. Black, Dallas, Texas.

THE following nominations for officers of the American Society of Mechanical Engineers for 1940 have been announced: *President,* Warren H. McBryde, consulting engineer, San Francisco; *Vice-presidents,* Kenneth H. Condit, consulting editor of *American Machinist,* McGraw-Hill Publishing Company; Francis Hodgkinson, honorary professor of mechanical engineering, Columbia University; J. C. Hunsaker, head of the department of mechanical engineering, the Massachusetts Institute of Technology; K. M. Irwin, Philadelphia Electric Company.

RETIREMENTS at the close of the academic year of members of the faculty of Northwestern University include: Dr. Herbert A. Potts, professor of oral surgery; Dr. William C. Bauer, professor of electrical engineering; William H. Burger, professor of civil engineering; Dr. William H. Haas, professor of geology and geography; and William G. Smith, professor of engineering drawing.

REAR ADMIRAL WAT TYLER CLUVERIUS, U. S. Navy, retired, has been elected president of the Worcester Polytechnic Institute. He will succeed Rear Admiral Ralph Earle, retired, who died in February after serving for fourteen years as president of the institute.

DR. WILLIAM H. MARTIN, professor of plant pathology at Rutgers University, has been appointed dean of the College of Agriculture at the university and director of the New Jersey Agricultural Experiment Station, to succeed Dr. Jacob G. Lipman. Dr. Martin has been serving as acting dean and acting director since the death of Dr. Lipman in April.

DR. EDWARD J. MOORE, professor of physics at the University of Buffalo, has been appointed dean of the Graduate School of Arts and Science.

DR. G. KINGSLEY NOBLE, curator of herpetology of the American Museum of Natural History, has been appointed visiting professor of biology in the Graduate School of New York University.

DRS. ROBERT D. BOCHE, of the Carnegie Laboratory of Embryology, and Irwin C. Kitchin, of the Rice Institute, have been appointed assistant professors in the department of zoology of the University of North Carolina.

DR. GEORGE R. COWGILL, professor of physiological chemistry at Yale University, has been elected editor of *The Journal of Nutrition* in place of Dr. John R. Murlin, who recently resigned. Also elected to the editorial board are Dr. Icie Macy Hoobler, Dr. Henry A. Mattill and Dr. Harold H. Mitchell. The editorial office of the journal after July 1 will be at New Haven, Conn.

PROFESSOR ROSS G. HARRISON, of Yale University, chairman of the National Research Council, delivered the Linacre lecture at St. John's College, Cambridge, on May 16. He spoke on the "Development of the Internal Ear—a Study in Experimental Embryology."

THE following series of lectures will be given at the Biological Laboratory, Cold Spring Harbor, Long Island, by Dr. Fritz Eirich, of the department of colloid science of the University of Cambridge: July 19, "Oxidation in Monolayers"; July 21, "Serum Reactions with Colloidal Tungstic Oxide"; and July 24, 26 and 28, "High Molecular Compounds." These lectures will begin at 2 P.M.

THE exchange of visits between the Kaiser Wilhelm

Gesellschaft of Berlin and the Royal Society, London, was continued on June 22 with a lecture by Professor F. Wever, of Düsseldorf, entitled "A Review of the Development and Present State of Metallurgical Research"; and on June 23 with a lecture by Professor Otto Hahn, of Berlin-Dahlem, who spoke on "The Fission of Uranium Nuclei by Neutrons."

THE Puerto Rico chapter of the honor society of agriculture, Gamma Sigma Delta, held its initiation banquet on May 20. The guest speaker was Dr. Harry H. Love, professor of plant genetics of Cornell University. Rafael Menéndez Ramos, dean of the College of Agriculture and Mechanic Arts, introduced the speaker. The eight initiates included five graduating seniors of the College of Agriculture, two members of the Puerto Rico Experiment Station, and one from the Insular Department of Agriculture. Following the initiation election of officers was held and the following were elected for the coming year: *President,* Professor Rafael A. Toro; *Vice-President,* Dr. Arthur G. Kevorkian; *Secretary,* Professor José A. Ramos; *Treasurer,* Professor Jorge H. Rodríguez; *Historian,* Professor Rivera Valiente.

THE Louisiana State University has completed the equipment of its new astronomical observatory by the installation of a Clark refractor of eleven and a half inches aperture. The principal address at the dedication ceremonies was given by Professor W. L. Kennon, of the University of Mississippi, who spoke on "Astronomy in America." The director of the observatory is Dr. David Vance Guthrie, professor of physics and astronomy at the Louisiana State University.

THERE has been organized at Youngstown, Ohio, the Mahoning Valley Academy of Science with about sixty members, most of whom are engaged as instructors in the Youngstown College or as teachers in the local high schools.

ACCORDING to the *Journal* of the American Medical Association, a new National Institute of Hygiene and Public Health in Lima, Peru, has been opened officially by the president of the republic. The institute, created by a government decree on July 23, 1937, is under the supervision of the ministry of public health, labor and social welfare. Dr. Telemaco Battistini is the director. It has three departments: bacteriology and immunology, entomology and experimental medicine. The department of bacteriology and immunology, which are directed by Dr. Battistini, will engage in the manufacture of serums, vaccines and glandular extracts, which will be sold to government controlled hospitals, municipalities and certain other public agencies at cost. The department of entomology, under the direction of Dr. Marshall Hertig, formerly of the Harvard Medical School, will for the present work exclusively on Carrion's disease, or "verrugas," which is endemic in certain areas of Peru, notably in Verrugas, about 99 kilometers from Lima. Later it is expected that research will be instituted on malaria, which causes the greatest morbidity of any disease in Peru. The department of experimental medicine, which is directed by Dr. Alberto Hurtado, professor of medicine in San Marcos University, will cooperate with the department of entomology in its study of Carrion's disease.

DISCUSSION

PLANKTON AS A FOOD SOURCE FOR MAN

ACCORDING to a recent news report the German State Biological Institute at Helgoland is investigating the possibility of harvesting the plankton of the sea as a new food source for the German market to make Germany still more independent of foreign imports. Zooplankton was reported to have a nutritive value equivalent to the best meat and phytoplankton to be equal to rye flour. Since the nature and abundance of the marine plankton has been the subject of several recent investigations at the Woods Hole Oceanographic Institution, it is of interest to examine the feasibility of the German proposal from the quantitative point of view.

There is no question that plankton is rich in food materials. A typical zooplankton catch, consisting chiefly of copepods, yielded the following analysis when dried:[1] fat 7 per cent., protein 59 per cent., carbohydrate 20 per cent. and chitin and ash 14 per cent. In fact, the fat content of crustacean plankton sometimes exceeds 30 per cent. Certain whales, sharks and many kinds of fish feed on plankton almost exclusively.[2] Plankton has been claimed to be palatable by biologists who have eaten catches of it on occasion, and shipwrecked crews "are said" to have subsisted on plankton strained through handkerchiefs.

There is plenty of plankton in the ocean, but the essential problem in the practical application of the scheme is the difficulty of separating such small organisms from the water in sufficiently large quantities. Considering first the phytoplankton (including nannoplankton), we know that for the ocean as a whole it must bulk larger than the zooplankton since the latter subsists upon it, but the extremely small size of the individual cells presents a very serious obstacle to mass collection. The most efficient method which has been developed has proven successful for obtaining diatoms in quantities large enough for chemical analysis (*i.e.*, by the kilogram),[3] but since the maximum rate at which the diatom sludge could be accumulated during periods of abundant flowering was a liter in about six hours and since the work involved the services of three men and a forty-foot power boat, the method obviously would not be practical for obtaining a food supply for man.

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[1] J. Johnstone, "Conditions of Life in the Sea." Cambridge, 1908.

[2] G. L. Clarke, Fifth Pacific Science Congress, Vancouver, B. C. A5. 5 p. 2017, 1934.

Zooplankton can be procured much more readily because its larger size makes possible the use of coarser nets which, due to their stronger mesh, can have larger filtering surfaces and can be towed at faster speeds. The abundance of zooplankton is extremely variable both in time and in place. But even in the relatively rich Atlantic coastal area between Cape Cod and Chesapeake Bay catches greater than 2 liters in volume (per 20 minute haul at 1.2 knots with net 1 m in diameter) were rarely encountered in a four-year survey reported by Bigelow and Sears.[4] These authors concluded that the average concentration of zooplankton in this area during the season of maximum production was about 0.5–0.8 cc per cubic meter of sea water. Plankton was much scarcer during the winter. Comparison with other investigations showed that the plankton of European waters was little, if any, richer. Since plankton is at least 90 per cent. water, we may take as an outside figure a value of 0.1 g dry weight of plankton per m^3 of sea water. Even though the plankton may actually be richer, this figure gives the order of magnitude of the amount *which can be caught* using the most efficient methods yet devised.

Since the foregoing data are available one is tempted to make a rough calculation of the amount of ocean which would be required to sustain a man. Assuming an energy yield of 9 cal/g for fat, and 4 cal/g for protein and carbohydrate, we find that the combustion of 1 gram of dried plankton would yield about 4 cal. If a value of 3,000 cal per individual be taken as the average daily requirement of the population,[5] about 750 g of plankton would be needed per man per day, *assuming all the organic matter in the plankton to be assimilable*. On the basis of 0.1 g plankton/m^3 each member of the population would require all the zooplankton from *at least* 7,500 m^3 each day (approximately equal to the volume of a football field filled 1.5 m deep). Using the largest net generally found practical (2 m in diameter)[6] at a fast towing speed (2 knots) and assuming a 20 per cent. straining efficiency for a coarse net,[7] a period of 2½ hours would be necessary to filter this volume of water. If several nets were used simultaneously, more men and larger boats entailing greater operating costs would be required.[8] Even though plankton be considered only as a subsidiary food source, it must be obtained economically in order to form an efficient part of the whole dietary scheme. We are forced to conclude, therefore, that if the marketing of plankton on a commercial scale is to become a practical reality, either areas of greatly increased richness must be located or some method must be found for making the above rate of procuring plankton economically feasible.

GEORGE L. CLARKE
HARVARD UNIVERSITY AND
WOODS HOLE OCEANOGRAPHIC INSTITUTION

IMMUNITY TO FUSARIUM WILT IN THE TOMATO

GREENHOUSE and field tests of the resistance of several wilt-resistant tomato varieties to *Fusarium lycopersici* Sacc. (F. *bulbigenum* var. *lycopersici* Woll.) showed that infection was almost universal when environmental conditions were very favorable for the development of the disease. The resistant varieties survived for longer periods than susceptible varieties, but usually died before the growing season ended.

In a search for more effective resistance to *Fusarium lycopersici* in a plant cross-fertile with the tomato, numerous accessions of Lycopersicum and related genera were exposed to infection by virulent isolates of the parasite. All accessions of species in genera other than Lycopersicum proved immune. A few attempts to produce intergeneric hybrids were not successful. Accessions of *L. esculentum* Mill. exhibited various degrees of resistance and development of external symptoms, but all were susceptible to infection. Accessions of *L. pimpinellifolium* Mill. from several sources varied greatly in reaction to *F. lycopersici*; one proved very susceptible; several were somewhat resistant; one, Accession 160, remained free from infection and apparently possessed immunity.

The immune accession of *L. pimpinellifolium* was received from Dr. W. S. Porte, U. S. Department of Agriculture, Washington, D. C., who wrote of it, ". . . our No. 2116 was obtained by F. P. I. from Dr. Wolcott, who picked it up near Trujillo, Peru."

In contrast to the resistance or tolerance of commercial varieties of tomatoes to *Fusarium lycopersici*, immunity in Accession 160 was effective under conditions very favorable to the development of the disease. In greenhouse and field experiments of 1935 to 1938, in which nearly all plants of commercial resistant varieties were infected, Accession 160 and its F_1 hybrids with susceptible varieties of *Lycopersicum esculentum* remained free from vascular discoloration. Injection of a suspension of a virulent isolate of the fungus into the stems failed to produce the disease in Accession 160 or in the F_1 hybrids, although plants of the Bonny Best variety used as controls were killed by the fungus within 28 days. Accession 160 was not infected on autoclaved soil infested with 39 isolates of *Fusarium lycopersici* from various regions of North America and other continents; several of these isolates killed all plants of Bonny Best and Marglobe checks within 45 days.

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[3] G. L. Clarke, SCIENCE, 86: 593, 1937.

[4] Memoirs of the Museum of Comparative Zoology, 1939 (in press).

[5] G. Lusk, "The Elements of the Science of Nutrition." Philadelphia, 1928.

[6] A net 4½ m in diameter but with relatively coarse mesh was used by the *Discovery* (J. W. S. Marr, *Discovery Reports*, 18: 105, 1938).

[7] Reported by G. L. Clarke and D. J. Zinn (*Biol. Bull.*, 73: 464, 1937) and confirmed by tests with the plankton sampler—a recently developed device equipped with volume meter.

[8] There might be some possibility of operating economically a filtering plant in the tidal flow between suitably located islands or in the entrance of an estuary.

Tests of several thousand plants in various progenies from crosses between Accession 160 and several susceptible commercial varieties proved that immunity to *Fusarium lycopersici* in tomatoes is dependent on a single, dominant genetic factor. The factor for immunity was maintained in the heterozygous condition in a series of 4 back-crosses to susceptible varieties. Its potency was not decreased in the fourth back-crosses or their progenies.

Large fruit size and various other characters of commercial value were obtained in some plants of advanced generations and many of the plants could not be distinguished from large-fruited forms of *Lycopersicum esculentum*. Although they were heterozygous for a large number of factors affecting fruit and plant characters, preliminary tests indicated that some plants in progenies from self-pollinated flowers of selections derived through outcrossing immune selections to commercial varieties for four generations were homozygous for immunity.

Various lines are being tested and subjected to selection to obtain plants homozygous for the factor for immunity, and for factors for desirable fruit and plant characters. The linkage relations of the gene for immunity are being studied. The data will be reported in detail, elsewhere, at an early date.

G. W. BOHN
C. M. TUCKER

UNIVERSITY OF MISSOURI

MAHOLI GALAGOS BREED IN CAPTIVITY

IN September, 1937, I received two Maholi galagos from South Africa. This is a well-known, dwarf variety of lemuroid with a body about six inches long and hind legs which are slightly longer than the body. Like all lemuroids, they are nocturnal, and this variety normally hops about in the tops of trees. In July, 1938, the female matured, but fertilization did not take place. On December 15, 1938, there was a second period of heat, and four months later, April 14, 1939, two galagos were born. So far as I have been able to determine, this is the first time that the Maholi galago has bred young in this country. There are many cases recorded of young having been born among the lemurs while in captivity in the various zoos abroad, and in some instances the period of gestation has been recorded. I am unable, however, to find any record of the period of gestation for the Maholi galago.

Just before the birth of the twins the expectant mother tore up quantities of paper in an effort to make a nest in a small box inside her cage. At birth the young were well covered with grayish fur and the eyes were partially open. They could cling to the perpendicular sides of the cardboard box in which they were born by means of their adhesive pads on both hands and feet. The mother, if disturbed, would clutch one of her offspring in her mouth, usually by the middle of its back or even by its ventral surface. She is able to jump as much as ten feet with her offspring dangling from her mouth.

FLORENCE DEL. LOWTHER

BARNARD COLLEGE,
COLUMBIA UNIVERSITY

ZOOLOGY FOR PRE-MEDICAL STUDENTS

A QUESTION which is raised by practically every student preparing for the study of medicine is, "How much science work, and particularly how many and what courses in zoology, should I take?" The answer, which I believe most deans of medical schools ordinarily give, is, "Take only those courses which are required for entrance to medical school."

In many liberal arts colleges, however, students who are preparing for the study of medicine are advised to take as much work in zoology as they can possibly get in. The usual assumption which is the basis of such advice is that the additional science work will better prepare the student to carry the medical curriculum. This seems logical, but, we ask, "Do these extra science courses sufficiently enhance the average student's ability to profit by the medical course to justify his taking them to the exclusion of other studies which in all probability he will never again have an opportunity to pursue?"

To throw some light upon this particular question we have compared the medical school grades in certain courses earned by students who had had similar courses in departments of zoology with the grades of other students in the same classes who had had no such courses. Specifically, the comparisons were as follows: The grades in gross human anatomy of one hundred students who had had comparative anatomy were compared with the grades of one hundred students who had not had this course; likewise the grades of one hundred students in human embryology, one hundred in human histology and fifty in human physiology who had had corresponding courses in "arts colleges" were compared to the grades of the same numbers of students who had had no such courses.

There were no significant differences between the abilities, as judged by average college grades and by average scores on Medical Aptitude tests, of the groups of students who had had and those who had not had the various zoology courses.

Analysis of these data shows that the students who had had comparative anatomy did approximately 10 per cent. better in gross human anatomy than the students who had not had such a course. The calculation of statistical probabilities indicates that there are 36 possibilities in 100 that this average difference in grades is due to the operation of chance in sampling. Whether one considers this probability as statistically significant is a matter for individual judgment, but, except for other possible values which the students might get from comparative anatomy, it is questionable whether the time and the effort expended are justified by the 10 per cent. better average work which the students who have taken comparative anatomy do in gross human anatomy.

In human embryology and in human histology there are no significant differences between the grades of the students who had had and those who had not had similar courses in the "arts college." Those students who had had a physiology course in a zoology department did not do as well in human physiology as those who had had no such course. This difference is sufficiently great to be considered statistically significant; although it is probably without much importance.

While this study may not answer the question as to how much work in zoology a prospective medical student might profitably take, it does present evidence that the argument that a student should take a multiplicity of zoology courses because they will specifically help him in his medical school work is fallacious. There may be a slight justification on this basis for recommending comparative anatomy, but there is none whatsoever for embryology, histology or physiology.

Harold S. Diehl

Division of Medical Sciences,
University of Minnesota

KILLING THE TERM, PREDATEE

In reply to Professor L. D. Wooster's "Proposing the Term, Predatee" (Science, 89: 436, 1939), may I point out that the word *prey* denotes "any animal that is or may be seized by another to be devoured" (second definition in Webster's New International Dictionary, second edition). Therefore, *predatee* is unnecessary and, we hope, abortive. This protest is not offered in the spirit of conservatism, for I have persisted, with others, in using such naturally formed and needed words as predator, predation and speciation, until they have become recognized by the lexicographers, and am continuing to take part in the process of word-speciation by using, for example, a new verb, *to speciate.*

Carl L. Hubbs

University of Michigan

SOCIETIES AND MEETINGS

THE ILLINOIS STATE ACADEMY OF SCIENCE

The thirty-second annual meeting of the Illinois State Academy of Science met in Springfield on May 5 and 6. The meeting opened with a general session held in the Centennial Building of the State Capitol group. The governor of Illinois, though unable to attend, sent a letter of welcome, and the superintendent of schools, R. E. Fildes, gave a short address of welcome. Dr. George D. Fuller, of the University of Chicago, the retiring president, presented an interesting paper on the interglacial and postglacial vegetation in Illinois. Dr. Charles A. Shull, of the University of Chicago, also gave a paper at the general session on plant growth and growth hormones. This session closed after short talks by Anton Tomasek, state forester, on state forests in Illinois and by Dr. Thorne Deuel, chief of the State Museum, on some interesting exhibits prepared by the museum staff especially for those attending the annual meeting.

The section meetings in the afternoon were unusually well attended, some 140 papers being presented in the nine sections offering programs. Several sections were obliged to divide their programs. One section in geology was virtually a symposium on geological features of Illinois. Chemistry, botany and zoology also were able to arrange separate programs around topics of specialized interest. The physics section met separately in the morning discussing with the representatives of medical schools in the state the problem of physics in premedical education.

Immediately after the section meetings a general business meeting and election was held. The officers of the academy for 1939–1940 are: *President,* Evelyn I. Fernald, botany, Rockford College; *First Vice-President,* Theodore H. Frison, Natural History Survey, Urbana; *Secretary,* Robert F. Paton, physics, University of Illinois; *Treasurer,* John Voss, Manual Training High School, Peoria.

Two resolutions of general interest were also passed unanimously:

Resolved, that the Illinois State Academy of Science hereby reaffirms its general approval of the efforts of the

Associated Conservation Organizations of Illinois to further the Commission plan for the administration of the Department of Conservation in Illinois as embodied in the resolution of the 31st Annual Meeting of the Academy published in the *Transactions* of June, 1938.

Resolved, that the Illinois State Academy of Science express its approval of any action of the State Legislature or of other agencies public or private looking toward the preservation of sites within the state which are of archeological, historical, and of scientific interest.

The Junior Academy had its usual enthusiastic meeting. Some fine exhibits were set up in the local high school gymnasium and the groups representing the many high-school science clubs in the state showed high enthusiasm. Dr. C. T. Knipp, of the University of Illinois, gave the evening address to the Junior Academy, giving some interesting demonstrations of his singing tubes and other experiments he has developed. Dr. H. K. Gloyd, director of the Chicago Academy of Sciences, gave the annual public lecture of the Senior Academy, talking on the animal life in the Arizona deserts.

The annual tradition of scientific pilgrimages on Saturday was maintained by four such excursions into the surroundings of Springfield, which are especially rich in scientific and historical material.

At the council meeting on Saturday it was voted that the next annual meeting be held in Galesburg, Illinois, on May 3 and 4, 1940.

R. F. PATON

UNIVERSITY OF ILLINOIS

THE NEW HAMPSHIRE ACADEMY OF SCIENCE

THE twenty-first annual meeting of the New Hampshire Academy of Science was held on June 2 and 3 at Dartmouth College, Hanover, N. H. At the Friday evening session, Professor W. B. Unger showed motion pictures of Australian mammals and birds, and Mr. A. E. Bent, secretary of the Mount Washington Observatory, showed colored films of the mountains, the work at the observatory and hurricane damage at high altitudes. There followed a social meeting at the Wilson Museum sponsored by the Dartmouth Scientific Association. Professor C. J. Lyon and others made an exhibit for this meeting of specimens of most of the local wild flowers of the season, and the Dartmouth Natural History Club exhibited a collection of over fifty kinds of living animals from the vicinity. Other demonstrations of the local bird studies and of new state and academy publications were on view.

At the Saturday morning session, the chief feature was a symposium, "The Hurricane of September, 1938, and its After-Effects." The meteorology of the hurricane was discussed by Professor C. F. Brooks, of the Blue Hill Observatory. Forestry aspects were treated by W. F. Hale, assistant state forester, and L. W. Rathbun, of the Society for the Protection of New Hampshire Forests. Mr. Kenneth Roberts spoke on flood control aspects, and T. J. Dent, of the New Hampshire Fish and Game Commission, and John Pearse, of the U. S. Biological Survey, discussed the effects of the hurricane on animals and game management.

On Saturday morning, the Dartmouth Eye Institute presented a program of four papers introducing their accomplishments and research projects. The Eye Institute was opened for the inspection of the academy members.

Saturday afternoon was given over to the reading of papers by other members, to the business meeting and to the address of the retiring president, Dr. Henry I. Baldwin, on "Scientific Freedom."

At the business meeting it was voted to award the grant-in-aid for the current year from the American Association for the Advancement of Science to Professor W. W. Bowen, curator of the Wilson Museum, Dartmouth College, for assistance in completing "A Survey of Bird Population Density in Relation to Various Ecological Factors." The publication committee announced plans for publishing a bulletin on "Glacial Geology of Mt. Washington" by R. P. Goldthwait and for replacing the mimeographed account of the annual meeting by a formal printed "Proceedings" containing abstracts of papers presented.

The following officers were elected for 1939–40: *President,* Professor George W. White, University of New Hampshire; *Vice-President,* Professor Bancroft H. Brown, Dartmouth College; *Secretary-Treasurer,* Professor W. W. Ballard, Dartmouth College; *Members of Executive Council,* Dr. Henry I. Baldwin, State Forestry Department, for five years, and Mr. Henry S. Shaw, Exeter, N. H., for three years.

W. W. BALLARD,
Secretary

THE NEW YORK STATE GEOLOGICAL ASSOCIATION

MORE than 160 persons attended the meeting of the New York State Geological Association on May 12 and 13 at Canton, N. Y., where the St. Lawrence University acted as host. The Gouverneur marble quarries, the Richville feldspar mine, where 42 different minerals have been found, the Edwards zinc mine, the Fowler talc mine, "Lost River," an underground portion of Boland Creek, the Reservoir Hill phacolith near Gouverneur, eskers, kames, pro-glacial deltas and lake features were visited in the field.

On Friday evening the annual dinner was held in the Men's Residence of St. Lawrence University, after which the following program was given: Address of Welcome, President Laurens H. Seelye; "Minerals of

St. Lawrence County," Dr. D. H. Newland, New York State Museum; "Some Aspects of Pleistocene Geology," Professor Earl T. Apfel, Syracuse University; "Adirondack Rocks in Kodachrome," and Movies of Buffalo Meeting, Professor H. L. Alling, University of Rochester; Report of Nominating Committee, Professor G. B. Cressey, Syracuse University.

The visiting delegates left for their homes on Saturday afternoon enthusiastic about the talks which they had heard and the geological features which they had seen and with their cars laden with mineral specimens collected.

The officers for next year are Professor George H. Chadwick, *president;* Robert W. Jones, *secretary-treasurer,* who will succeed Dr. Robert Wesley Brown and Dr. John S. Brown, retiring president and secretary-treasurer, respectively. The association is eagerly looking forward to next year's meeting, which will be held in the Catskills.

FIELD CONFERENCE OF PENNSYLVANIA GEOLOGISTS

THE ninth annual meeting of the Field Conference of Pennsylvania Geologists was held in West Virginia from May 27 to 30. More than fifty geologists from New York, New Jersey, Pennsylvania, Virginia and West Virginia attended.

The conference hosts were the members of the West Virginia Geological Survey. The 1939 committee consisted of Dr. Paul H. Price, state geologist of West Virginia, *chairman;* Dr. B. L. Miller, Lehigh University; Dr. R. E. Sherrill, University of Pittsburgh, and M. N. Shaffner, Pennsylvania Topographic and Geologic Survey, secretary and treasurer.

The annual dinner was held at the University of West Virginia at Morgantown on Sunday evening. A welcome was extended to the group by the president of the university, Dr. Charles E. Lawall. Other speakers were, Dr. Paul H. Price; Dr. Arthur Bevan, state geologist of Virginia; Dr. B. L. Miller; Dr. R. W. Stone, Pennsylvania Topographic and Geologic Survey; E. T. Heck, West Virginia Geological Survey; Professor Herbert Woodward, University of Newark, and M. N. Shaffner.

The committee accepted an invitation from the New Jersey Geologists to meet with them in New Jersey in 1940, and the following committee was appointed for that meeting: Dr. Meredith E. Johnson, state geologist of New Jersey, *chairman;* Professor Herbert Woodward; Dr. Bradford Willard, Pennsylvania Topographic and Geologic Survey, and M. N. Shaffner.

On Sunday the excursion covered strata from Lower Mississippian to Upper Pennsylvanian in the area between Morgantown and White Sulphur Springs. On Monday strata from Upper Ordovician to Middle Mississippian were covered between White Sulphur Springs and Petersburg, and on Tuesday strata from Upper Silurian to Lower Mississippian were covered between Petersburg and Berkley Springs. The leaders were Dr. Paul H. Price, E. T. Heck, Herbert Woodward and Professor H. M. Fridley, West Virginia Geological Survey.

M. N. SHAFFNER,
Secretary and Treasurer

SPECIAL ARTICLES

THE RELATION OF "COENZYME R" TO BIOTIN

THE value of yeast or plant extracts as stimulants to growth of the root nodule bacteria (*Rhizobium* sp.) has been long recognized. Allison, Hoover and Burk[1] explained the stimulation on the basis that the extracts provide a specific coenzyme for respiration (Coenzyme R), and concluded that the active agent "is certainly not identical with bios, since its addition to synthetic medium essentially free from bios resulted in growth of yeast negligible compared with the heavy growth obtained where bios was present." Apparently, it has been assumed by many workers that this implies that biotin, a growth factor for yeast, is not a growth stimulant for rhizobia, a conclusion which does not necessarily follow from the foregoing statement.

Evidence obtained in this laboratory strongly indicates a relationship between the growth factor requirements of yeast and rhizobia. Treatment of yeast extract with acids, alkalies, solvents, adsorbents and oxidizing agents resulted in parallel preservation or destruction of the activity for both *S. cerevisiae* and *R. trifolii.*

During preparation of biotin concentrates by the procedure of Kögl and Tonnis,[2] fractions were tested at each stage of purification, and total units and purity of the active factor assayed by growth of *S. cerevisiae* and *R. trifolii.* The concentration of biotin, as assayed by yeast growth, was accompanied by the same degree of purification of the Rhizobium factor, until the norite adsorption step was reached. Unexpectedly, the eluate (biotin fraction) was highly active with *R. trifolii,* but inactive with yeast. On addition of a small quantity of the filtrate, however, the activity for yeast was completely restored. Further investigation disclosed that the filtrate factor could be replaced by synthetic β-analine. Following this lead, a preparation of "Coenzyme R" obtained from *Azotobacter* by the method of Hoover and Allison[3] was tested, and it was found, in agreement with these workers, that alone it was completely inactive with yeast. When 0.1 gamma per ml of β-alanine was added, however, the preparation stimulated yeast growth in a manner identical with that of the biotin concentrate. For maximum growth response, it required 5 gammas per ml of the former, but only 0.3 gamma of the latter. With a given level of either "Coenzyme R" or biotin concentrate, a maximum in the curve of yeast stimulation was obtained in the region of 0.05 to 0.5 gamma per ml of β-alanine. With *R. trifolii* near maximum stimulation was obtained with either "Coenzyme R" or biotin alone; addition of 0.05 gamma per ml or over of β-alanine gave a small but consistent supplementary effect. It is not surprising that β-alanine is much less effective with *R. trifolii* than *S. cerevisiae* since the former is apparently capable of decarboxylating aspartic acid to form β-alanine.[4] The growth of *R. trifolii* was not decreased when the amount of β-alanine was raised to 1.0 gamma per ml. These results have been confirmed with several species of *Saccharomyces* and *Rhizobium*.

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[1] F. E. Allison, S. R. Hoover and D. Burk, SCIENCE, 78: 217, 1933.

[2] F. Kögl and B. Tonnis, *Zeits. Physiol. Chem.*, 242: 43, 1936.

Consideration of these data leads to the following alternative conclusions:

(1) "Coenzyme R" and biotin are identical.

(2) "Coenzyme R" and biotin are distinct, but with such similar chemical and physical properties that we have not been able to separate them by any of the procedures indicated.

(3) "Coenzyme R" and biotin are distinct, but each acts as a growth stimulant for either or both yeast and rhizobia.

Final decision with regard to the relationship must necessarily rest until both factors are available in pure form. However, until a more purified "Coenzyme R" is prepared which definitely shows no activity for yeast even in the presence of β-alanine, conclusion 1 appears to be the simplest assumption. If the two factors are distinct, the present evidence favors conclusion 3, *viz.*, that biotin also is a stimulative factor for *R. trifolii*.

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SAND CULTURE[1] OF COTTON PLANTS

The successful culture of many vegetables and flowers in water, sand, cinders, etc., suggested that this technic might be useful in research on the physiology of the cotton plant. Publications on the subject have been scattered in scientific and lay journals; in those available to us, no references to the culture of cotton plants were found.

Preliminary attempts to grow cotton seedlings by immersion of the roots in nutrient solutions were not successful. However, when the young plants were placed in sand,[2] they grew to maturity. The seeds were germinated between moistened filter papers and when the roots were from 1½ to 2 inches long, each was transplanted to a washed clay flower pot (4-inch diameter) containing wet sand. The sand was kept wet by irrigation twice daily with distilled water. Every third day, the sand was flooded with the culture solution. The solution used was that recommended by the New Jersey Agricultural Experiment Station as described by Ellis and Swaney,[3] and contained the following ingredients[4] dissolved in distilled water:

	Parts per million
$Ca(NO_3)_2$	740
KH_2PO_4	310
$MgSO_4$	280
$(NH_4)_2SO_4$	95
$FeCl_3$	8.5
H_3BO_3	0.85
$ZnSO_4$	0.48
$MnSO_4$	0.46
$CuSO_4$	0.07

The pots were kept on the window sills of a chemical laboratory with southern exposure. On clear days, they received approximately two hours of sunshine. Despite these abnormal environmental conditions, growth was steady and fairly rapid. Some plants attained a height of 100 cm in 100 days. In periods of mild weather, numerous squares[5] developed, several of which opened to form the cotton flower. Most of the bolls were shed within two weeks after the flower[6] appeared. In two instances, however, bolls set and developed normally. Although they were small, the seeds were fertile and the lint mature.

The cotton plant may thus be grown successfully under the artificial régime described. Conditions were far from optimal as indicated by the large numbers of shed squares and an abnormally long time required for maturation of the bolls. With a more favorable environment, the method might be used advantageously to study the basic and optimum requirements of the cotton plant. It would be particularly useful in determining the role of trace elements in growth and fruiting.[7] The optimal ratios of essential elements, such as N : P, could be investigated. Information on the cause of shedding might be obtained.[8] The technic also can be used in studies of plant metabolism.[9]

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[3] S. R. Hoover and F. E. Allison, *Trans. 3rd Internatl. Cong. Soil Sci.*, 1: 158, 1935.

[4] A. I. Virtanen and T. Laine, *Enzymologia*, 3: 266, 1937.

[1] The term "psammoponics" to designate sand culture has been introduced by W. A. Hamor, *Ind. Eng. Chem., News Edition*, 17: 1, 1939.

[2] 20–30 mesh standard sand.

[3] C. Ellis and M. W. Swaney, "Soilless Growth of Plants," Reinhold Publishing Co., New York, 1938.

[4] The ferric chloride is made up in a separate solution and added to the medium just before use.

[5] Cotton flower buds.

[6] The flowers last 24 hours.

Thus, this procedure, as a useful method in determining the physiological requirements of the cotton plant, may ultimately be helpful in improving the yield of lint and seed. In the present plight of cotton agriculture, any means for reducing the cost of raising cotton merits especial attention. Lower production expenses, and hence economically sound decreases in price, would stimulate domestic uses and the export trade.[10]

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[7] Although the unglazed pots were washed, it is possible that traces of an essential element or elements were slowly leached from them. Growth experiments in glass containers would be more conclusive.

[8] According to Brown, "Even where there are no insects to bother, more than half the flowers that open fail to make bolls that mature." H. B. Brown, "Cotton," McGraw-Hill Book Co., New York, 1938, p. 124).

[9] The root system is easily obtained for analysis by washing away the coarse sand in a stream of water. According to macroscopic observation, no particularly fine root hairs develop. The availability of water and nutrients apparently renders them unnecessary.

[10] It is necessary to give credit to the Cotton Research Foundation (see SCIENCE, 87: 87, 1938). Since this paper was submitted we have learned that sand culture of cotton has been practiced for some time at several southern agricultural experiment stations.

PHYSICO-CHEMICAL PROPERTIES OF THE ROUS CHICKEN TUMOR AGENT[1]

THE agent causing Rous chicken tumor I may be separated from cell-free tumor extracts by high-speed centrifugation (Ledingham and Gye, McIntosh, Elford and Andrewes, Amies, Claude, Pollard). The purified material serving for the present experiments was prepared essentially according to Claude[2] with the aid of an *air-driven ultracentrifuge.*[3] The *nitrogen content* was 8.9 per cent. The material is precipitated from its strongly opalescent solutions by half-saturation with ammonium sulfate and by protamine. It contains thymonucleic acid. Even after four sedimentations in the high-speed centrifuge the material gives a positive hemochromogen reaction. Amounts of 10^{-7} to 10^{-9} gm produced typical sarcomas in chickens. *In vitro* the material exhibited cytochrome oxidase and catalase activity (unpublished experiments with Mr. J. L. Melnick). It remains to be decided whether these enzymatic activities are intrinsic properties of the tumor-producing agent or whether they are due to associated substances.

The solutions of the purified agent show no appreciable flow double refraction. Their relative viscosity is 1.3 in 1 per cent. solutions after complete removal of the highly viscous mucin material present in crude tumor extracts. Measurements by the falling drop method of Barbour and Hamilton,[4] for which we are *indebted to* Mr. P. H. Barbour, Jr., *indicate* a density of 1.23. Preparations purified by four alternate high-speed (30,000 r.p.m.) and low-speed (2,600 r.p.m.) centrifuge runs, when examined in the analytical ultracentrifuge by the light-absorption method, yielded a mean sedimentation constant $s_{20} = 550 \times 10^{-13}$ cm dynes^{-1} sec^{-1} (Fig. 1).

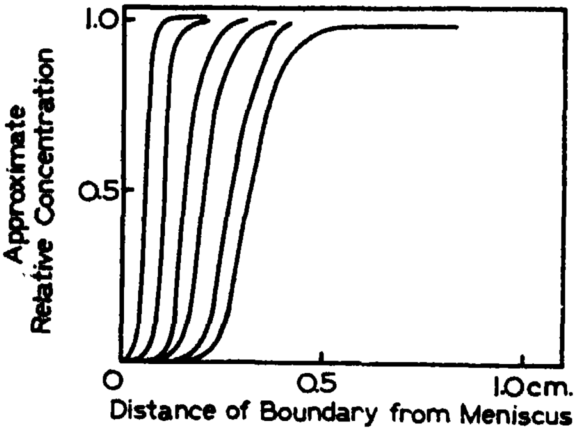

FIG. 1. Tracings of microphotometer curves obtained from sedimentation photographs of purified Rous chicken tumor I agent. Concentration of material, 1.08 per cent., in 0.005 M. phosphate, pH 7.3; mean gravitational force, 3,500 *g* (7,200 r.p.m.); intervals between exposures, 6 min.; length of exposure time, 5 sec. (Eastman positive film); λ = 2,480 – 3,600 A (high-pressure mercury arc, bromine filter); photographic magnification, 1.5; magnification ratio during recording, 1 : 6.

The macromolecular material prepared from normal chick embryos according to Claude[5] shares many physico-chemical properties with the Rous chicken tumor I agent. The average sedimentation rate of two purified preparations was found to be $s_{20} = 532 \times 10^{-13}$ cm dynes^{-1} sec^{-1}.

While only one boundary could be observed upon sedimentation of the preparations from chicken tumor I and normal chick embryos the spreading of the boundary in the course of the runs indicated a relatively low homogeneity of the materials. The figures given above represent the sedimentation rates of the particles of average size present in populations of particles of somewhat differing dimensions. The more extensively purified preparations were found to be free from foreign proteins which are unsedimentable in the gravitational fields employed. There is a marked tendency towards aggregation upon storage at low temperatures.

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[1] This investigation was aided by a grant from the Jane Coffin Childs Memorial Fund for Medical Research.

[2] A. Claude, *Amer. Jour. of Cancer*, 30: 742, 1937; SCIENCE, 87: 467, 1938.

[3] J. W. Beams, F. W. Linke and P. Sommer, *Rev. Sci. Instr.*, 9: 248, 1938.

[4] H. G. Barbour and W. F. Hamilton, *Jour. Biol. Chem.*, 69: 625, 1926.

[5] A. Claude, *Proc. Soc. Exp. Biol. and Med.*, 39: 398, 1938.

The calculation of the size and mass of the tumor-producing material from the sedimentation constant and density requires a knowledge of the shape of the particles. The absence of birefringence both in flowing solutions and in the gel-like pellets formed during ultracentrifugation, and, more directly, the observation of round, uniform particles in such preparations upon microscopical dark-field examination (Ledingham and Gye, McIntosh, Amies, Claude) indicate a symmetrical shape of the agent, in spite of the relatively pronounced viscosity of its solutions. The application of Stokes's equation for spherical particles yields a mean value for the diameter of the particles of 70 mμ. This, in turn, leads to values for the average weight of the individual particles of 2.3×10^{-16} gm and for the average "molecular weight" of 139×10^{6}. These figures are in close agreement with the results secured by ultrafiltration[6] and non-optical centrifugation[7] experiments.

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ON THE NATURE OF THE AGENT CAUSING LEUCOSIS IN FOWLS[1]

THE work of Ellerman, Furth and others has shown that fowl leucosis, in contrast to mammalian leukemia, can be transmitted by cell-free plasma and tissue extracts. The virus strain used in the present investigation was Strain No. 1 of Dr. J. Furth, to whom the authors are greatly indebted for the supply of original donor material. Fifty per cent. of the chickens inoculated intravenously with whole blood and 28 per cent. of those inoculated with whole plasma developed the disease.

Centrifugation of heparinized leucotic plasma in the chilled quantity rotor of an air-driven ultracentrifuge[2] for 30 to 60 minutes at 23,000 r.p.m. (gravitational force at the bottom of the tubes, 37,400 g) yielded a small, colorless flaky sediment in addition to a yellow, translucent jelly-like pellet. Suspension of the sediment in M/15 phosphate buffer (pH 7.3), after removal of aggregated matter in the horizontal centrifuge, gave an opalescent solution showing a pronounced Tyndall effect. Pellet solutions prepared from active plasma have produced leucosis in 3 out of 11 chickens after intravenous injection.

Marrow of the long bones provided a richer source of the macromolecular material. Upon grinding frozen leucotic bone marrow with sand, extraction with 0.005 M. phosphate (pH 7.4) and removing cell debris in the horizontal centrifuge (2,600 r.p.m.), strongly opalescent solutions were obtained. These produced leucosis in 4 out of 10 injected chickens. When such crude marrow extracts were subjected to ultracentrifugation at speeds ranging from 23,000 to 30,000 r.p.m. (max. gravitational force, 37,400 to 63,300 g), substantial pellets were obtained containing all the material responsible for the strong opalescence of the crude extracts. The material was purified by resuspending it in 0.005 M. phosphate (pH 7.4), removal of aggregated matter by low-speed centrifuging (2,600 r.p.m.), resedimentation of the macromolecular material in the ultracentrifuge (30,000 r.p.m.) and repetition of the entire procedure. The average yield of macromolecular material after four ultracentrifugal sedimentations was 11 mg from 1 gm of bone marrow. Only traces of macromolecular material were obtained from normal bone marrow under the same conditions.

Material prepared in this manner from leucotic bone marrow has produced leucosis in 4 out of 19 inoculated chickens. The remaining 15 birds are still under observation. With the exception of one instance, where contamination with pellet material could not be excluded, supernatant solutions from both plasma and bone marrow ultracentrifuge runs were inactive (20 chickens). It should be mentioned that although microscopic examinations of pellet material have definitely excluded the presence of cellular material in a few tests, in other instances cellular debris was observed. It remains to be determined whether this material might be responsible for some of the positive results obtained.

Purified macromolecular bone marrow material contains about 9.5 per cent. nitrogen. Color reactions for thymonucleic acid are positive. Hemin can be demonstrated by the pyridine hemochromogen test. The material possesses cytochrome oxidase and catalase activity (unpublished experiments with Mr. J. L. Melnick). It remains to be determined whether these enzymatic activities are due to the agent itself or to small amounts of associated substances.

In the analytical ultracentrifuge the material sedimented with a single boundary which tended to spread during the course of the runs, indicating a relatively low degree of inherent homogeneity. From microphotometer tracings (Fig. 1) obtained from sedimentation photographs of bone marrow material purified by four ultracentrifugations an average sedi-

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[6] W. J. Elford and C. H. Andrewes, *Brit. Jour. Exp. Pathol.*, 16: 61, 1935.

[7] W. J. Elford and C. H. Andrewes, *Ibid.*, 17: 422, 1936; J. McIntosh and F. R. Selbie, *ibid.*, 18: 162, 1937; A. Claude, *J. Exp. Med.*, 66: 59, 1937.

[1] This investigation was aided by grants from the Jane Coffin Childs Memorial Fund for Medical Research and the Fluid Research Fund of the Yale University School of Medicine.

[2] J. W. Beams, F. W. Linke and P. Sommer, *Rev. Sci. Instr.*, 9: 248, 1938.

mentation constant $s_{20} = 582 \times 10^{-13}$ cm dynes^{-1} sec^{-1} has been calculated. On the assumption that the particles possess spherical shape, which is supported by the absence of flow double refraction and by the low relative viscosity of their dilute solutions (1.09), the average diameter of the individual particles, as derived from the sedimentation constant with the aid of Stokes's equation, is 72 mμ. Using the value of 1.22 for the density of the material (kindly determined for us by Mr. P. H. Barbour, Jr., by the falling drop method of Barbour and Hamilton) an average particle weight of 2.6×10^{-16} gm and a "molecular weight" of 146×10^{6} is obtained.

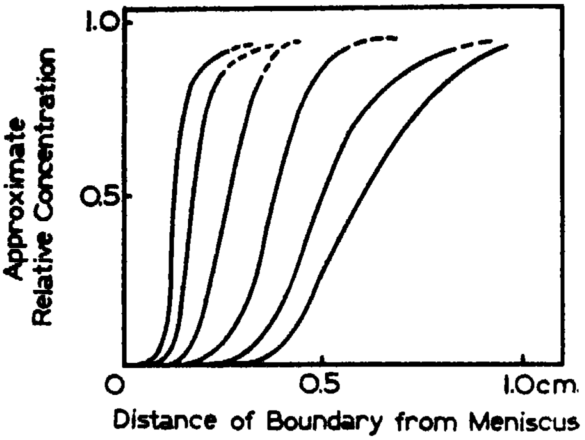

FIG. 1. Tracings made from the microphotometer curves of the sedimenting boundary of macromolecular material isolated from bone marrow of leucotic chickens. Material purified by four alternate high-speed (30,000 r.p.m.) and low-speed (2,600 r.p.m.) centrifuge runs; concentration, 0.5 per cent., in 0.005 M. phosphate (pH 7.4); mean gravitational force during analytical run, 3,500 g (7,200 r.p.m.); interval between exposures, 6 min.; λ = 2,480 – 3,600 Å; photographic magnification, 1.5; magnification ratio during recording, 1: 6.

With respect to its chemical and physical properties the material described above resembles the causative agent of the Rous chicken tumor I[3] and also the macromolecular material isolated by Claude[4] from normal chick embryos. In contrast to the virus proteins isolated by Stanley and others from plants, these materials do not represent pure nucleoproteins but much more complex chemical structures of the type encountered in the analysis of protoplasm.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE SIMPLEST TRANSPARENT ULTRACENTRIFUGE

WE have developed a form of transparent ultracentrifuge which permits of photographic recording of the contents of a glass or quartz tube while spinning at 110,000 times gravity. It is so simple that it dispenses entirely with accessories, not even a camera being required. The complete equipment can be made in fifty to sixty hours of a mechanician's time. Nevertheless, it gives useful results of fair accuracy.

The device is a development of ideas previously used by Elford, McIntosh and Selbie, and Ford, but applied to obtaining a record without stopping the rotor. This consists, Figs. 1 and 2, of a solid piece of duralumin, 7 cm in diameter, and directly air-driven. In the upper surface two channels are milled on the same diameter; one carries a dummy to balance the cell. In the other is placed first a piece of photographic film and upon it a block of hard rubber with a horizontal hole to hold a tube of 1.5 mm internal and 7 mm external diameter, containing the solution to be measured. The rubber block is sawn nearly in two, giving a radial vertical slit 0.6 mm wide. The tube is sealed at the outer end and closed at the other end with a piece of gummed paper with a piece of cork pressing against it to assist insulation. The length of column of liquid we have used is 8 mm, but may readily be longer. It therefore has ample resolving power for the smallest proteins. The rotor has a cover screwed on with a central screw. In the cover is a window, set in with Duco or similar

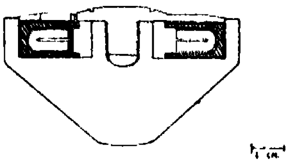

FIG. 1. Cross section through assembled rotor.

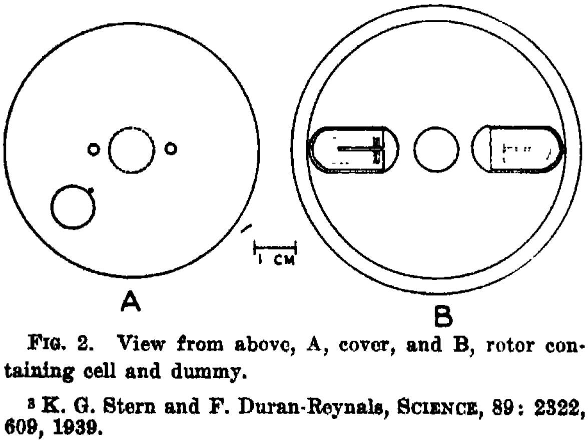

FIG. 2. View from above, A, cover, and B, rotor containing cell and dummy.

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[3] K. G. Stern and F. Duran-Reynals, SCIENCE, 89: 2322, 609, 1939.

[4] A. Claude, *Proc. Soc. Exp. Biol. and Med.*, 39: 398, 1938.

nitrocellulose cement. There is also a hole 0.5 mm in diameter just next to the window nearer the axis of the rotor to serve as reference point. About 30 cubic feet of air are required per minute if the pressure is 100 pounds per square inch. The stator should also be 7 cm in diameter.

The run is made in dim light or with a cover placed over the guard around the rotor until the record is desired, whereupon a distant light or a collimated beam is flashed on for about one second. This places upon the photographic film a spot representing the reference point, a boundary for the top of the tube or edge of the window, another for the liquid meniscus and a graduated image showing any boundary or optical inequality in the liquid from top to bottom. Only one record has been made for each run, but it should be easy to arrange a slit or opening which can be moved outwards to successive positions, and exposed in each.

This was developed for the study of petroleum products in non-aqueous solution, but we quote here some test runs on sedimentation velocity in earthworm blood diluted 10:1 with 1 per cent. potassium chloride solution. These can be made at the rate of several an hour, owing to the fact that the direct air-drive brings the rotor to full speed almost immediately, so that zero time can be taken when the air is full on. Instead of one tube, two to six can be measured simultaneously in the same rotor.

The duration of each sedimentation was 5 minutes. The values of sedimentation constant $s \times 10^{13}$ were successively 58.2, 57.7, 58.9, 55.5, 57.6, 53.7, 60.8, which, reduced to 20° C., become 59.2, 60.0, 61.0, 57.9, 60.0, 55.9 and 63.4. The mean is 59.6. Svedberg's values for $s20°$ were from 56.4 to 64.3, mean 60.9.

The cylindrical tube is of course not radial, but this is of very minor importance. There is a controlled convection outwards, confined to within a few particle diameters of the periphery of the tube with the correspondingly small upward movement of all the remaining volume, thus giving a sedimentation velocity very slightly too small, as in the example given. If desired, the usual type of radial sectorial cell may be used. A detailed description of the rotor and stator will be published elsewhere.

It would appear that the ultracentrifuge in this form could now be made available for undergraduate classes in biochemisty and colloids.

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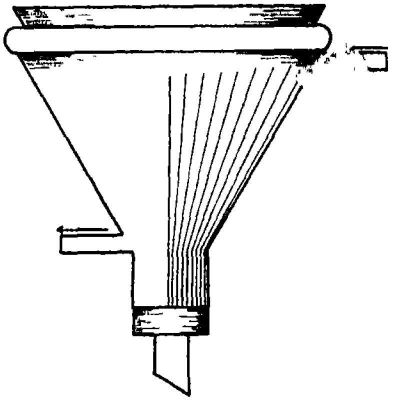
FUNNEL-HEATING DEVICE

With the necessity for frequently conducting hot filtrations has arisen the need for more efficient and practical means of keeping funnel contents hot than is afforded by older forms of funnel-heating devices. These forms, whether of coils or double-wall jackets, lack satisfactory heat transfer, making it difficult to keep alcoholic solutions boiling. There is also a serious fire hazard where gas heat has to be applied to maintain the temperature.

The present device, a front view of which is illustrated, consists of a single-wall metal jacket, which fits around the bell of a funnel and makes steam-tight connections by means of a rubber gasket at the top and a bored rubber stopper on the stem. The compressive stress in the rubber keeps the device locked tightly against the glass so that no leakage of steam occurs. Inlet and outlet nipples are provided for the steam. Since the steam impinges directly against the outer surface of the glass funnel, the heat transfer is at its maximum efficiency, and alcoholic solutions can be kept at the boiling point. If a steam line is not available, the device can be operated satisfactorily with steam generated in a flask on the laboratory table. Among other desirable features are the transferability from funnel to funnel, use with funnels considerably larger than the device itself and rugged construction. The device is patented and is now on the market.



FUNNEL-HEATING DEVICE

Fig. 1

L. N. Markwood

Bureau of Entomology and
Plant Quarantine,
U. S. Department of Agriculture

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